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CERTAIN ALLUREMENTS IN PHYSICS[1]

There is no doubt as to the alluring nature of physics. We are led on as reasoning, imaginative dreamers who never attain full intellectual satisfaction but who are always sufficiently rewarded to be happy to participate either as workers or as spectators. The fascinating quality of physics is not our concern here, but in the atmosphere of the recognition of this drawing and compelling power, certain of our present problems will be briefly discussed.

It is doubtful if ever there has been a more inviting appeal to imaginative reason than can be found at present in atomic structure and radiation theories. The search in this field is, in fact, so exciting that we can easily forget the mysteries in our own hypotheses. The progress of the last decade has been rapid. Only thirteen years ago Professor Rutherford in his Winnipeg address set forth the claim that sufficient evidence had at that time been adduced to place the theory of the existence of atoms in the classification of accepted fact. To-day, with perhaps equal conservatism, several details as to the structure of the atom can also be regarded as accepted. The existence of the nucleus, with a diameter of about 10^{-12} cm. or less no one doubts, though our direct evidence is based upon but one type of experiment, namely, the impact of an α particle. The size of the charge of the nucleus, its sign and the fact that α particles and H particles exist in at least some of the nuclei are certainly just as true. But we would be willing to sacrifice a great deal to know more of the content of and arrangement in nuclei. We may be nearer the acceptance of the existence of α particles, protons and electrons as the units of structure in all nuclei than some of us realize. Reasonable deductions from isotopic measurements may convince us as to this composition, but at the moment the experiments of Rutherford and Chadwick upon H particles give us the hope of a direct and hence a more valuable means of attack. The extension of the measurement of the masses of isotopes with the remarkable present accuracy developed by Aston and Dempster will undoubtedly lead to the recognition of classifications that will at least indicate, if not prove, nuclear composition, but the interpretation of the H-particle experiments demands a very much higher accuracy. Rutherford and Chadwick have produced H particles from the nuclei of six of nineteen light elements and in five of the six with an increase in total kinetic energy of from 6 to 42 per cent. of the kinetic energy of the colliding α particle. A consideration of the relativity change in mass of the H particle is important, although perhaps not yet profitable. For the kinetic energy of a 7 cm. α particle is $.009c^2$ per gram-atom, c being the velocity of light, hence the change in mass produced by this energy is .009 grams per gram-atom, or in atomic weight units, .009 for each α particle. If at impact 42 per cent. of this energy is acquired by the nucleus and α particle as shown by experiment, there must be a total increase in mass of $.42 \times .009$ or .004 or 0.4 per cent. of the mass of an H particle, or .01 and .03 per cent., respectively, of the masses of aluminum and boron, two of the elements concerned. At least this accuracy in atomic weight measurements must be obtained before a relativity consideration can even begin. The development of highly improved methods is of great importance.

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[1] Address of the vice president and chairman of Section B, physics, American Association for the Advancement of Science, Boston, December, 1922.

In regard to the arrangement and activities of the extra-nuclear electrons, the status of atomic structure theory is rapidly improving. Three years ago at this session we had a discussion in which a suggested reconciliation of the so-called static and orbital theories was presented. At the present time one can say with a fair degree of confidence that reconciliation is neither probable nor desirable. The static theory appears superior as a picture to be used in the discussion of periodic physical and chemical properties of the elements, the magnetic properties and compound formations. The orbital theory appears to be a more powerful method of attack, partly because it is not hindered by a consideration of the mechanism of radiation and partly because it relies upon principles and mathematical methods instead of upon visualization. The attempt to mix the two would probably seriously decrease the future real benefits of both. The static atom is valuable not merely because the spacial relations can be visualized but also because, to the extent that it affords such an excellent partial explanation of phenomena and is successful in the predictions of properties of new compounds, it must have a measure of truth. But in some respects it is misleading. Conventionality must not be accepted as a reality. The use of the term "cell" leads to a perhaps unconscious satisfaction that does not bear analysis. Moreover, the position of an electron in a cell on the outermost shell seems to make molecular formation much easier than if the electron has any sort of orbital motion. But yet the converse may be nearer the truth. This is not an effort to criticize the static atom theory. It is merely a reminder of the danger of overenthusiasm concerning any explanation that depends upon visualization.

The present orbital theory of atomic structure, as enunciated by Bohr, is strikingly different both as to content and as to value. It is less of a picture and more of a theory. Stability is not neglected but emphasized. So detailed has become the development of the theory that perhaps a brief non-technical description is appropriate to this address. Until recently our orbital conception based upon the work of a number of contributors could be sketched in the following manner. The fundamental assumption was a generalization of Planck's quantum, which not only gave the frequency relation, but stipulated stationary states of an atom system. By orbits, circular or elliptical, with a central nucleus and a single electron radiating as it passed from one stationary state or energy level to another, the Balmer, Paschen and Lyman series of atomic hydrogen and the series of ionized helium were computed with high accuracy. By assuming elliptical orbits and a relativity change in mass of the electron, the fine structure of hydrogen approximately and of ionized helium more exactly, were obtained. Extending the theory and assuming internal X-ray energy levels, X-ray doublets were computed and found to agree with experiment. By assuming the presence of an unsymmetrical field external to the nucleus and inner electrons, the well known series formulæ of the alkali metals could be quickly derived. By the application of an electric field, not only the general phenomenon but also the details of the Stark effect were obtained. The Zeeman effect was explained as well as was formerly done by the classical theory. By the application of the "correspondence principle" the intensity and state of polarization of lines for large orbits and more approximately for small orbits were obtained. But in this remarkable theoretical work, producing quantitative agreements that were exceedingly impressive, no account was taken of the spacial distribution of orbits and no explanation was given of the variation of physical and chemical properties as shown by the periodic table. We had, then, two pictures of atomic structure, one with electrons in cells and shells, and one with electrons in coplanar orbits. But because a spacial distribution of electron orbits was demanded on several grounds, some progress was made in considering such a distribution by the polyhedral symmetry of electrons which in the coplanar model had the same orbit. Bohr's recent description in the Zeitschrift für Physik of 1922 seems to abandon a rigorous theoretical approach but, at the same time, to profit by the theoretical investigations of the foregoing idealized conditions. He adheres to the quantum theory and applies the correspondence principle as a substitute for our lack of knowledge of the inner connection which determines the possibility of radiation or a quantum change. He concludes that there is no modification in the former hydrogen atom model. The helium atom in the normal state has two approximately circular electron orbits, having an angle between their axes o° 120°, with the planes turning slowly about the fixed axis. Preliminary computations promise the experimental value of the ionizing potential. These helium orbits remain a fixed substructure in all elements of higher atomic numbers. Bohr ascertains the structure of succeeding elements in the periodic table by obtaining an answer to the question, "How can the atom be built through successive seizure and binding of the single electrons in the field of force surrounding the nucleus?" He is led by this approach to a conclusion as to the nature of the orbits of the elements. Briefly, the orbits are approximately circular, elliptical and highly elliptical, resulting in an interpenetration of orbits. Electrons having relatively large energies will, on account of the greater ellipticity of their orbits pass closer to the nucleus than do other electrons possessing smaller energies and moving in orbits of less eccentricity. The visits to the interior by a group of electrons in noncoplanar elliptical orbits of a certain energy, do not occur simultaneously, for the electrons approach the nucleus alternately with equal time intervals. Because of the interpenetration of orbits there is an intimate coupling of the electron orbits of the different groups indicated by quantum numbers, and also an independence of the nature of the binding of the electrons of one and the same group. Bohr discusses the entire periodic table, showing how this structure may explain the chemical and physical periodic phenomena. He has abandoned rigorous treatment, merely because it is no longer possible. Another new result of Dr. Bohr's investigation is that at four different regions in the periodic table, the added electrons find more stable adjustments by becoming members of groups formed earlier in the building up process. The ferromagnetic metals are near the end of such an inner change or what might be termed the healing process of an internal wound of the atom.

In the above it is observed that our former relatively simple picture of an orbital atom has gone and we have, in an atom of high atomic weight, a maze of interpenetrating orbits too complicated to visualize. But we have a description of the atom in terms of quantum numbers and nuclear charges. While this remarkable conception looks very promising indeed, we must patiently await a very slowly accumulating rigorous treatment. The forthcoming publications of Dr. Bohr will be received with great interest. He is just publishing an article on X-rays in collaboration with Dr. Coster in which there is derived a very strong support for the main features of the new theory. He has been working out and will soon publish details in regard to the series spectra and will show that the new views throw much additional light in respect to the main feature and also the quantitative details.

The above description will indicate that an attempted reconciliation between the static and orbital theories would probably prove either unsuccessful or unprofitable. We ought to be willing to use either theory freely wherever of service. But it is almost inevitable that in the future, though we may adhere to pictures for elementary students, in the work of investigation we will get further and further from models and become more and more satisfied with principles which, although not containing ultimate explanations, nevertheless are apparently the nearest approach to the truth. Obviously the function of pictures is seriously limited, for our natural ability to gain by visualization does not increase materially from generation to generation, whereas our power of attack through mathematical investigations based upon principles does accumulate with the elapsing years. It is not surprising, therefore, that it is easy to have more faith in the greater fruitfulness of the orbital theory as compared with the static theory.

It is folly to prophesy seriously as to the direction of future progress in the theory of atomic structure. But there are certain evidences that are worthy of consideration. The quantum theory seemed a few years ago to be a curious as well as a remarkable element in Planck's theory of radiation, the oddity of the quantum reflecting merely the difficulties of the problem. To-day, we regard a quantum theory more seriously. Although not as consistent as the classical theory, its use in radiation is or should be just as orthodox. While formerly we were inclined to call attention to the formal character of the theory and the failure to explain any mechanism underlying it, to-day we realize that neither the classical nor the quantum theory gives us the mechanism. This mechanism, though fundamental, is a detail and the evidences is that we can make progress more rapidly by following a successful formal principle than by speculating about the nature of the mechanism itself. Our willingness to adopt as a working theory such a formal principle is not a fault but a virtue. Such a principle attacks, as it were, from without and its successes and failures are determined in that region. Hence we can not hope to judge or improve the method by speculations from within. Progress in atomic structure can certainly be anticipated by following either the quantum theory or perhaps a substitute not yet suggested. The accumulation of data along our present restricted lines of experimentation must of course be of permanent value. But until another formal principle is found that is more successful than the quantum theory or until a hitherto unsuspected region of observation is opened up, we can scarcely expect any material modification in our present views of atomic structure in so far as they are applicable to experimental test. But we have not arrived. The attack upon the problem has but begun. The allurement remains.

Having commented upon the most attractive problem in physics, I turn now by way of contrast to a field regarded by many as possessing but little interest. During the war many physicists remarked that acoustics was at last coming "into its own." Only in a limited sense was this true. Acoustics does not inquire as to the nature of its assumed continuum and hence is not a fundamental subject. It can never have the attractiveness of a fundamental field in which a small amount of progress may eventually lead to an extensive accumulation of valuable results. The chance of enlivenment in acoustics through new discovery is slight. But while the allurements are less the achievements for an individual may be more satisfactory because of their permanent value. This permanency rests upon two facts. In the first place the truth in the assumptions and approximations are clearly understood and any theoretical advance will not need to be thrown aside because of the incorrectness of the bases adopted. Moreover, the importance of acoustics will not wane. In this respect optics and acoustics are similar, for their interest to the race will last as long as will human vision and audition. Progress in acoustics undoubtedly is limited, but its importance will persist. I speak not as an advocate for greater attention to acoustics, neither would I urge in business one particular line over another. Men will go into big business enterprises, some to win and some to lose. Other men will be more conservative, taking less of a gambler's chance and consequently neither winning nor losing so great a stake. These differences in adjustment to allurements exist in the field of scientific research as well, and one must select that kind of investigation in which he can be most effective and happy. It is unfortunate, however, that physicists generally do not appreciate that acoustics is a difficult field, begging for the attention of masters of mathematical methods. The late Lord Rayleigh had a great mind, as is attested by his numerous contributions in almost all branches of physics. It has often been wondered why he remained strangely inactive toward such an attractive subject as the electron theory. The speaker, in the absence of information, is of the opinion that Lord Rayleigh's interest was controlled in part by the promised permanency of results. In acoustics he must have been attracted by the substantial correctness of the assumptions, for this insured a corresponding quality in the results obtainable by mathematical processes. It is much to be hoped that acoustics will receive an increasing share of the interest of our mathematicians.

Mathematical difficulties arise in even the most simple acoustical devices. For example, a solution has not been found for the "end correction" of a conical horn. Until recently there has been no theory which included a discussion of the natural vibrations in a conical horn which are not radial, but Dr. V. A. Hoersch has now found how to compute the frequencies of these other resonance frequencies, his solution providing for a horn of any angle, but with an infinite plane flange. An experimental test of this unpublished theoretical investigation has not been made. This same investigator has also shown the reason for the existence of an "optimum" horn angle. When a conical horn is used as a receiver there is an angle for which the amplification will be a maximum, assuming fundamental resonance. This angle is less when the vibration is an overtone than when it is the fundamental of the horn. But measurements demonstrating this effect require the escape of a small amount of energy at the vertex. It has now been proved by a fairly simple theoretical investigation that the cause of an optimum angle is this escape of energy. Were this loss zero, the amplification would continue to increase with decreasing angle until viscosity became a factor of importance. It is clear, then, that the adjustment of a conical horn as an amplifying receiver requires not only a knowledge of the frequencies involved but also of the nature of the apparatus at the vertex even though it may absorb but a small amount of energy. The suggestion should be made, in passing, that the incorrect conception of a conical horn as a collector of the incoming energy should soon be supplanted by a correct recognition of the horn as a resonator.

Acoustic problems are not without attractiveness *per se*. The acoustic wave filters just described in the December *Physical Review* are uncommonly interesting and partly because of the element of surprise. We are familiar with the nature and behavior of the medium and by daily experiences with sound transmission. Yet we are hardly prepared by experience to witness an unobstructed cylindrical tube an inch in diameter and a few inches long that refuses audible transmission to a large group of frequencies. Up to the present time, successful low-frequency-pass, high-frequency-pass and single-band and double-band filters have been constructed. Additional contributions to the theory by other workers, but not published, will probably add filters of a different type. Just what the future usefulness of the acoustic wave filters will be can not be estimated. But the permanency of our method of hearing with air as a medium necessitates the continued importance of methods of filtering which use this same medium. Moreover, as presented, the fundamentals of the theory apply to any medium whatsoever. This may prove of significance in several directions.

But it is not my purpose to discuss present problems of acoustics in any detail. Reference has been made merely to several items of progress in which the speaker's interest has been keen and in which the allurements have certainly been strong. It is appropriate, especially in this laboratory where we are in session to-day, that reference be made to one who here did much for the field of acoustics, Professor Wallace Clement Sabine. The desire is not to laud his contributions but to speak in simple terms of him as a person. There is very clear in memory his act of kindness to the speaker who was a young experimenter in another laboratory. It betrayed a genuine human interest that, wherever found, compels admiration. His mind was keen and full of suggestions to the students in this Jefferson Physical Laboratory. Although kind and generous, he was intensively a just man. Never aggressive in a bold sense, others sought him out. He was essentially modest, but he had confidence in his mental powers. He was fine in spirit, outwardly highly acceptable and, withal, a splendid type of gentleman. One can not forget him as a person.

G. W. Stewart

University of Iowa

THE ORIGIN AND STRUCTURE OF PLANT GALLS[1]

The study of the histology of pathological tissues of plants has been very much neglected, especially in America. It is true that more or less extensive studies have been recorded and discussed in the papers on the various diseases of plants but nothing has been done towards bringing this data together into a comprehensive whole. In recent years this phase of botany has begun to attract attention, especially in the case of abnormal growths, which have been referred to under many names, such as cecidia, galls, cancers, hypertrophies and various terms which are more or less indefinite. It is the purpose of this paper to give a brief historical review of the phase of plant pathoanatomy which is involved in these abnormal structures. The fact that the author has made rather extensive studies of those plant galls which are the result of insect stimuli may be a sufficient excuse for attempting to discuss this very broad subject involving similar abnormal plant structures which are attributed to other organisms. Abnormal growths on plants are caused by insects, nematodes, fungi, slime molds, bacteria and chemical and mechanical irritations. Similar growths are also produced on animals; but, in general, it may be said that the causes are not nearly so well understood as in the case of plants. On the other hand the histology of abnormal animal growths has been the subject of much more extensive studies than that of those found on plants.

The plant galls which are caused by insects were among the first to attract attention and the early Greek literature contains many references to them. However, very little real progress was made until Malpighi published his "De Gallis" in 1686. This work was primarily descriptive but the author also advanced the theory that the excitation was due to a poison secreted by the mother insect. Although this idea was disproved long ago, there are some text-books which still retain this so-called "chemical theory" of more than two hundred years ago. The next great advance was about fifty years ago and was marked by Adler's "Ueber den Generations-wechsel der Eichen Gallwespen," a work dealing entirely with oak galls caused by insects. The works of Adler, Beyerinck and their contemporaries gave us very definite information concerning the life history of some of the causal insects and the structures of certain insect galls, and disproved the theory that the excitation was due to a fluid secreted by the mother insect.

The European literature is much more extensive than the American. In this country the major part of the work has been by entomologists but within recent years has attracted the attention of several botanists and papers have been published by Cosens, Rosen and Wells. Felt's "Key to Insect Galls" is the most complete and usable work in our American literature for the determination of these plant growths. He lists and describes more than 1,400 species, a number which is no doubt insignificant when compared with the number of undescribed species. In most cases each species of insect cecidium is confined to a single specific host plant and those that occur on more than one host are restricted to closely related species.

A few species of nematodes are well known as the causes of abnormal plant growths. They are widely distributed throughout the world, especially in the tropical and subtropical climates and the literature is voluminous. It appears that the Reverend M. J. Berkeley, the mycologist, was the first to describe and figure the nematode root galls and to recognize that they were due to an animal organism (1855).

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[1] Address of the vice-president and chairman of Section G, Botany, American Association for the Advancement of Science, Boston, December, 1922.

Fungi are the causes of many abnormal structures, such as cedar apples, peridermium growths on conifers, witches' brooms and other hyperplasias of various types which are so well known to botanists that it is not necessary to more than mention them at this time, although they will receive further consideration in the course of this discussion. Slime molds are the causes of some few abnormal growths; the most important being the well-known "club root" disease of cruciferous plants caused by *Plasmodiophora brassicæ* which will be referred to later.

Bacteria are recognized as the causes of such well known abnormalities as crown gall and hairy root, olive knot and legume tubercles. The first of these has received a great deal of attention in recent years because of certain resemblances to animal cancers. Crown gall attracted the attention of the European workers more than sixty years ago but the American literature contains practically no references of importance previous to 1891. Interest in this line of study received a very great impetus in 1907 when Smith and Townsend announced the discovery of the causal organism which they designated as *Bacterium tumefaciens*. The later work of these authors and of Hedgcock, Levine and others of the last quarter of a century is well known to this audience. The studies of the olive knot have been much less extensive. The legume tubercles have been the subject of extensive studies with reference to the organisms producing them and their economic value, but comparatively little attention has been given to their origin and structure. It is very well known that the abnormalities designated as "œdemas" are the results of chemical irritations; and that calluses and some other enlargements are frequently due to mechanical irritations. They have received very little attention.

Many problems have been suggested in connection with the study of plant galls. One of the earliest had to do with the nature of the irritant and has never been answered satisfactorily although centuries have elapsed since it was first proposed. Another and more recent inquiry involved the relationship of these growths, especially the crown gall, to animal cancers. Unfortunately the workers on these various groups of galls have very generally possessed but little knowledge of the other groups. It appears to the writer that it is desirable to correlate our knowledge of these various groups of galls as a basis for future study in this very interesting and important branch of botany.

We have previously stated that the old idea that insect galls were due to a chemical secretion by the mother insect is no longer accepted by the students of the subject, except possibly in the case of a few Nematus galls. Adler also showed that there was no cell division or growth until the larva emerged from the egg. Whether the very rapid growth and cell division which follows this event is due to the voracious feeding of the larva or to a chemical secreted by it is a problem which is likely to remain unsolved for some time to come. Küster is of the opinion that the excrement of the larva of *Pontania salicis* is capable of causing cell division in the host plant and this idea is supported by Cosens in his study of our American species, *P. pomum*. Both of these workers have also carried on experiments demonstrating that the larvæ of some of the Cynipidæ secrete enzymes capable of changing starch to sugar. The most generally accepted views at the present time are: (1) that the stimulus is purely mechanical; this may possibly be true sometimes, but certainly is not true in the majority of cases, (2) that the stimulus is due to a chemical action; this is more plausible in the light of modern research. However, in the case of insect galls the stimulus must come from the larva rather than from the mother insect. In the case of some insects the egg is within the tissues of the host plant and the emerging larvæ attacks the meristematic cells. In the case of some other insects the egg is placed on the surface of an incipient organ and there is no gall formation until the young insect emerges, when a more or less well defined pocket gall is produced. In this case we have no positive evidence as to whether the gall is the result of a chemical or a mechanical irritant. However, there is undoubtedly a growth beyond the point of irritation. It is also generally believed that the stimulus endows the protoplasm with the power to develop new tissues or organs, but Cosens has advanced the more plausible theory that these new tissues and organs "are due to the awakening of dormant characters in the protoplasm." The characters are already present and the stimulus enables them to develop.

Nematodes work their way through the tissues and no doubt stimulate growth during their journeys and after coming to rest, but we do not know whether the stimulus is mechanical or chemical. However, cells not directly in contact with the organisms are stimulated to activity. Our data on galls caused by fungi with reference to this phase of the subject are very limited and unsatisfactory. It is very evident that the stimulus must be applied to meristematic cells. The ramifications of a fungus through the tissues extends the area of stimulation and development, but it also appears that cells not in contact with the fungus enlarge and divide. The slime mold, *Plasmodiophora brassicæ,* penetrates the cells, causing both cell enlargement and cell division, but in this case the neighboring cells which have not been attacked also undergo division, apparently due to some substance passing from the infected to the uninfected cells. Division also occurs in cells which are not in direct contact with the infected cells and may be due to pressure in both cases.

Galls caused by bacteria show considerable variation and may be divided into three groups as follows: (*a*) those in which the bacteria occupy small pockets and stimulate the surrounding cells, as in the case of the olive knot; (*b*) those in which the bacteria are within the cells as in the case of the legume nodule forming bacteria; (*c*) those of the crown gall type which are not well understood, although it is known that they are not in the vessels or in the intercellular spaces. Smith at first attributed the formation of the crown gall to bacterial products or toxines which escape from the infected cells. But in 1917 after successfully producing abnormalities by the use of a number of chemicals, both acid and alkaline, and also with distilled water, he came to the conclusion that "any soluble substance whatever, except a killing, a plasmolyting or an oxygen absorbing substance, if continually liberated in excess locally in tissues, would be competent to induce tumor formation." He also says "that dilute ammonia causes intumescences and have rendered it probable that ammonia liberated within the cell in small quantities by the imprisoned bacteria must be one of the causes of the excessive and abnormal cell proliferation in crown gall. Probable amin compounds also help to determine it. Since an acid and an alcohol are likewise produced by crown gall bacteria and this alcohol and this acid (as well as other acids) in pure dilution and also in combination with ammonia caused galls or intumescences in my experiments the acid (or acids), the alkalies and the alcohol must, I believe, act together in producing tumors, and *osmotically rather than chemically.*"

The reactions of host plants to parasites are many and various, but we are dealing with those which have to do with stimulations and hyperplasias. These structures appear on a great number of species of plants and are caused by organisms belonging to a very large variety of different species of animals, plants and bacteria. They are produced on all parts of the host plants and the external forms of these growths are very numerous but the histological structures are few and harmonious, regardless of the causal organisms or the species of the host plant. In fact it is doubtful if there are any new histological structures. The writer has repeatedly called attention to the fact that there are three well-defined stages in the formation of plant galls: (1) cell enlargement or cell division or both, (2) the failure of the affected part to differentiate into the characteristic tissues of the normal plant organ on which the gall is formed, and (3) the differentiation into the characteristic tissues of the gall. The writer and others have also called attention to the fact that in the Cynipidous galls which show the most complex histological structures, the tissues are organized into four well defined concentric zones surrounding the larval chamber.

The first stage in the development of the gall, regardless of host plant or causal organism, is cell growth—either cell enlargement or cell division or both. The result is the development of parenchyma tissue from which differentiations into other tissues may or may not arise. A number of years ago the writer called attention to the fact that plant galls caused by insects could be grouped into four classes on basis of the complexity of their structure; also that the more highly developed galls pass through all the stages represented in the simpler galls during their development. Later studies on galls due to other causes and a study of the recent papers by other workers lead me to believe that most and possibly all of the various types of plant galls can be placed in some one of the four classes just referred to regardless of causal organisms, although in some cases the distinctions are not so well defined as in the most highly developed of the insect galls. These views have been very generally confirmed by the later investigations of Cosens and Wells.

Adler as a result of his studies on the Galls of the Cynipidæ, which are the most complex, believed that the egg must be placed so that the emerging larva would feed on the cambium; otherwise it would perish and a gall would not be formed. This is probably true of the galls which he studied but is not true of the galls which are due to many other organisms.

Küster has classified galls on the basis of presence or absence of cell differentiation into two great groups: (1) *kataplasmas* or those in which the structure is undifferentiated parenchyma and (2) *prosoplasmas* in which there is a differentiation into other tissues. In the prosoplasma group we find all gradations from galls with very slight differentiation of tissues to those in which the structures are very complex. Wells calls our attention to the fact that galls caused by Rotifera, Copepoda, Nematoda, Orthoptera, Neuroptera, Coleoptera, Lepidoptera, Musidæ, Chalcidæ and Tenthrenidæ must be classed as kataplasmas; while the Acarina, Psyllidæ, Aphidiæ, Coccidæ, Itonididæ and Cynipidæ include many galls which are kataplasmas and many others which are prosoplasmas. To these may be added the galls of *Plasmodiophora brassicæ* on the Cruciferæ, which are true kataplasmas and the bacterial and fungus galls which include kataplasmas and simple prosoplasmas, and also the intumescences and callous growths which are very simple kataplasmas. When the cell growth of the plant is stimulated, we find cell enlargements or cell division or both and great reduction of intercellular spaces; in fact, these changes take place before there is any visible enlargement of the organ. In many cases, the leaf-inhabiting aphids cause abundant cell division resulting in a compact mesophyll of very small cells and sometimes a division of the palisade cells without any thickening or other abnormality of the leaf.

Since the galls which are formed as a result of animal injuries give us the greatest range for study we will give them first consideration and the other types of galls will be compared with them. Since the Rotifera and Copepoda galls are represented by one species each and both are classed as the kataplasmas we will omit them from consideration. We will also omit most of the galls caused by insects, taking only those which are necessary to demonstrate the facts. Members of the Acarina are the causes of the simplest of the leaf galls. The first effect of the attack of these organisms is increased cell division. In some cases it is followed by the development of numerous trichomes, forming the socalled Erineums, and in others by the formation of pocket galls lined with trichomes. Some of them never pass beyond the kataplasma stage while others show a slight differentiation and may be considered as the simplest of the prosoplasmas.

The members of the Aphidæ are the causes of large numbers of plant galls which are especially prominent on the foliage. They are mostly of the pocket type and originate by increased cell activity. In some cases the cells tend to form zones but without differentiation. Some of them are strictly kataplasmas while others are prosoplasmas in which there has developed a considerable amount of fibrous tissue.

The Itonididæ (Diptera) contain a larger number of species of insects which cause galls than any other group. The galls also present a much greater variety of forms than those of any other group, but none of them show as high a degree of structural complexity as the galls of the Cynipidæ. Some of them are distinct kataplasmas while others are well developed prosoplasmas; many of them have the protective zone of sclerenchyma and the nutritive zone of parenchyma which are so characteristic of the Cynipidæ.

Species of the Cynipidæ are the makers of most of the oak and rose galls which have attracted so much attention. Some few of them are kataplasmas but most of them are highly developed prosoplasmas. They are more complex in structure and the tissues are more highly developed than the galls produced by the members of any other group of organisms. These galls originate in all cases from the most active meristematic tissues and the first stage involves very active cell division. Some of these galls never develop beyond this point and are true kataplasmas but most of them undergo very rapid differentiation resulting in the development of four well-defined zones. The innermost zone is composed of very rich parenchyma cells on which the larva feeds and is known as the nutritive zone. It is surrounded by a zone of sclerenchyma cells which is very thick in the small galls and correspondingly thin in the large galls. This is surrounded by a zone of parenchyma cells, in which fibrous structures are sometimes intermingled. It is thin in small and thick in large galls. The epidermis is the fourth and outer zone.

In recapitulation of these insect galls we can say that they all originate from the meristematic cells and are at first true kataplasmas. Many of them pass into the prosoplasma stage in which fibrous and sclerenchyma tissues are more or less prominent. In most cases the sclerenchyma is new to the organ on which the gall is produced. The fibrous tissues may or may not be new and in many cases this point is difficult to determine. In many cases I am satisfied that the fibrous tissues of the plant organs, especially the roots and stems, are merely pushed out of place by the development of other cells and that sometimes these misplaced tissues have been mistaken for new ones. So far as the writer is able to determine, insect galls never originate on mature plant organs but always during early periods of very active growth.

The literature on the nematode galls is very conflicting but it is evident that the point of excitation is less definite than in the insect galls. The writer is inclined to believe that the excitation must be restricted to tissues which are more or less meristematic and it is doubtful if the xylem tissues are ever changed except as they may be distorted by pressure exerted by the growth of other cells or possibly in some cases crushed or torn. If this interpretation is correct, these galls must be classed as kataplasmas. It also appears that the form and character of the abnormality depends largely upon the age of the root at the time of the infection and the number of individual worms attacking it.

Our knowledge of the origin, structure and development of galls due to fungi is more satisfactory than that of galls due to other causes. In the various papers on galls which are caused by fungi, the discussions have to do with the fungus rather than with its effect on the tissues of the host plant. However, it appears that the reaction is restricted to the tissues that are not highly differentiated and in most cases to those that are decidedly meristematic. Some of them are readily classed as kataplasmas while others are prosoplasmas of various degrees of complexity. The most satisfactory studies are found in the cases of the cedar and apple rust fungi, although there are some galls caused by fungi which are less complex and others which are more highly developed. Unfortunately, their structures have received very little attention. In all cases the direct modifications are mainly in the parenchyma tissues. The modifications of the fibrous structures appear to be indirect. The cedar galls have been studied by a number of investigators whose ideas are extremely divergent and confusing. Alban Stewart believes that galls of *Gymnosporangium juniperi-virginianæ* arise from axillary buds. He finds that each gall contains two fibrovascular systems, one derived from the incipient stem and the other from the leaves. The parenchyma tissues predominate and the fibro-vascular structures are dwarfed and modified. He finds practically the same condition in the galls of *G. globosum*. Reed and Crabill, who studied *G. juniperi-virginianæ* at about the same time, believe the galls arise from the leaf but otherwise their conclusions are not materially different. They further say: "The parenchyma of the leaf is stimulated to excessive growth, the fibro-vascular system, which is close to the point of infection, becomes much contorted and branched and radiates through the forming cedar apple." Again they say: "The fibro-vascular system is a modified continuation of the fibro-vascular system of the cedar leaf. From or near the base of the cedar apple, where the vascular systems are contorted, arise many branches which extend radially almost to the cortex." This description indicates that the origin and structure of these galls are similar to those of the Cynipidous galls. In their description of the effect of the fungus on the structure of the apple leaf, they say: "The hypertrophy of the apple leaf is due almost entirely to an excessive enlargement and multiplication of the spongy parenchyma cells. These cells become elongated, stand perpendicular to the upper epidermis, and form what at first glance appears to be a continuation of the palisade layer. The palisade layer, though, always remains intact and its cells, which are much smaller and more uniform in size and shape than those of the hypertrophied spongy parenchyma, are only slightly if at all enlarged. The intercellular spaces of the spongy parenchyma are entirely obliterated." This description is in harmony with that of the simple galls or kataplasmas which are due to insects. The writer has studied a number of other plant galls due to fungi and has found them to conform quite well in origin, development and structure to galls in general. Some of them are true kataplasmas while others are prosoplasmas. However, much work is necessary before it will be possible to classify these galls in their true morphological relationship.

The galls caused by *Plasmodiophora brassicæ* have been the subject of considerable research in recent years by Lutman, Chupp and Kunkel and the data concerning their development and structure is much more accurate than that of the fungous galls. They are true kataplasmas and it is evident that the cortex of the host reacts to the organism, that the cambium is especially susceptible, and that the cells of the medullary rays between the xylem also respond to the stimulus. The organism is sometimes found in the xylem but has very little if any effect upon it. The distortions of the xylem are evidently due to the force exerted by the infected rays and other parts. Instead of increasing the amount of woody tissue the action of the organism on the cambium tends to prevent the formation of vascular elements.

The bacterial galls so far as studied must be classed as kataplasmas, or possibly in some cases very low forms of prosoplasmas. The tubercles formed on the roots of the leguminous plants due to the action of *Bacillus radicicola* appear to originate and develop in the cambium of the cortical tissue and are true kataplasma galls. The so-called olive knot appears to be a true kataplasma originating in or very near the cambium, but the literature is indefinite on this point. The crown galls have received more attention than any other of the bacterial galls in recent years. The studies up to date indicate that all meristematic cells react to this organism but the character of the galls evidently depends largely on the activity of these cells at time of infection. The cells divide rapidly and therefore are very small as in galls due to other causes, more especially those in which the organism acts on the cambium of the host. It is very evident that in the formation of the crown gall, the irritant must be in the tissues which are more or less meristematic. Smith found that the dormant and old, hard, slow growing tissues were unfavorable for inoculation; but that when he used young, rapidly growing organs, he obtained good results; sometimes 100 per cent. infection. He also found that shallow inoculations into the cork cambium gave small galls while inoculations into the region of the true cambium gave vigorous tumors. The writer is inclined to believe that the size and character of the gall depend largely on the tissues infected and that the xylem seldom if ever reacts to stimulation from *B. tumefaciens*, although it is very possible that the sheath cells do respond to stimulation. The most complex and definite galls arise from the cambium, the less complex galls may arise from other meristematic tissues. The development of rather weak fibrous tissues in the galls indicates that the crown gall is a low type of prosoplasma. However, there is much greater variation in the amount of fibrous tissue in different crown galls than in more highly developed galls due to other causes. The crown gall agrees very generally in its origin, development and mature structure with other plant galls regardless of the causal organism. However, there is certainly one and possibly three marked differences between some of the bacterial galls and galls due to other causes: (1) The presence of the tumor strands in the crown gall, (2) Possibly the stimuli in the bacterial galls are more prolonged or more variable in location than in galls due to other causes, (3) The formation of embryomas or tumor containing leaf shoots or roots which have been attributed to the crown gall. The first appears to be a very clear and well-defined feature of crown gall but not of other types of bacterial galls; the second and third are open to question and should receive further study. In considering the second point we must call attention to the fact that a gall passes through periods of youth, maturity and old age, the same as any organism or organ of a normal plant. In some species, the period of stimulation is short and in others it is very long. In discussing the third we must call attention to the tendency of most of our higher plants to produce buds and shoots in or near the nodes when stimulated or injured. Furthermore, abnormally large fruits are frequently formed as a result of decortication of the stems. It is well known that similar conditions may arise as a result of winter injury, insect and fungous injuries. One of the most striking is the formation of aerial tubers on potato plants as a result of attacks of *Rhizoctonia solani.* In all these cases the conditions appear to be due to a physiological disturbance, which interferes with the descent of elaborated foods through the phloem and cortex. The question naturally arises as to whether the pathologic conditions arising from the injuries referred to above are comparable to the pathologic conditions arising from infection with *B. tumefaciens.* That is, are excessive shoot growths following injuries, enlarged fruits following decortications and other injuries, aerial tubers following attacks of *Rhizoctonia solani* comparable to embryomas following inoculations with *B. tumefaciens?*

In answer to a series of questions by the writer, Dr. Smith defined embryomas as "crown galls containing aborted shoots, often in great numbers," and stated that they differed from aerial tubers on potatoes resulting from attacks of *R. solani* in "that the aerial shoots from these aerial tubers have no disoriented tumor tissues in them and come from *normal situations, i. e., from* eyes, while the crown gall shoots are adventitious." He also stated that the shoots which resulted from inoculations with *B. tumefaciens* do not differ from shoots which arise as a result of other injuries, except that the tumor tissues mingle with them and that as the tumor tissues grow the shoots are injured and aborted.

Levine after working with the crown gall on *Bryophyllum calycinum* says that the leafy shoots do not occur until after the galls are established; that *B. tumefaciens* is not the cause of the formation of the leafy shoots but inhibits and retards normal development. In brief the formation of the leafy shoot is mechanical and secondary to the formation of the gall. This idea is in harmony with the prevailing opinion concerning the formation of aerial tubers on the potato plants following attacks of *R. solani.* In this connection we must take into consideration that the production of buds where they do not normally occur as a result of stimulation by *Plasmodiophora brassicæ* has been reported by Woronin, Favorsi and Kunkel. The latter author says: "The tissues of such buds are always infected. In most cases they grow into short fleshy shoots. The leaves are thick, distorted and abnormally succulent. In other cases the buds grow and give rise to sprouts of considerable size. Such sprouts may push above the surface of the ground and become green. One interesting thing shown by the diseased buds is that they are often unable to respond normally to gravity. Sometimes they arise on the under side of a root and grow directly downward. In other cases they arise laterally and turn downward like the young sprout. They have also been observed to grow out horizontally, but this is not common as downward growth." However, the fungous, slime mold and bacterial galls differ from the more highly developed insect galls in that in the case of the more complex insect galls the development ceases very suddenly with the maturity of the larva while in the case of the other galls there is no such sharp and well-defined cessation of cell activity.

In this discussion the writer has repeatedly called attention to the fact that all galls originate in practically the same manner regardless of the stimulus which excites their growth; that although some are more complex than others, the complex types pass through the stages found in the lower forms. This very naturally leads us to look for the key for our interpretation. This subject has been discussed in an interesting paper by Wells who takes as the foundation of his studies the following statement by the writer: "The morphological character of the gall depends upon the genus of the insect producing it rather than upon the plant on which it is produced. The families show parallel lines of development from a low form to a high form." This statement was published twenty years ago and attracted more attention in Europe than in America, because the workers of Europe have given much more attention to the anatomy of pathologic plant structures than the workers in America.

Wells takes Beyerinck's division of galls into indefinite and definite growths, which was advanced in 1877, and amplified by Küster in 1911 into kataplasmas and prosoplasmas and presents phylogenetic lines of development which are very suggestive. The results of his studies reaffirm the following statements of the writer as published nearly twenty years ago: "(1) Within each family we find certain morphological resemblances, (2) The families show parallel lines of gall structure to a high form." Wells's studies reaffirm the idea expressed by the writer that all galls originate with the excessive development of parenchyma tissue. His studies may be summarized as follows: (1) He accepts Küster's groupings into kataplasmas and prosoplasmas as the basis of his work. (2) He points out that prosoplasmas have arisen from the kataplasmas by evolutionary processes. (3) Kataplasmic evolution is the result of progressive inhibition of differentiation ending with tissue homogeneity. Prosoplasmic evolution begins when homogeneity has been attained, and is the development of new tissue characters.

The most important facts in gall formation may be summarized as follows:

(1) The original theory that insect galls were formed as a result of a chemical injected by the mother insect was disproved many years ago.

(2) In most cases the stimulus is probably due to an excretion by the organism; in the case of insects, by the larva. In some cases the stimulus may be due to pressure or other mechanical factors.

(3) The stimulus must be applied to the meristematic tissues. The reaction depends largely on the degree of activity of the meristematic tissue.

(4) The reaction of cells to the stimuli is remarkably similar regardless of the stimulating factor involved.

(5) Cells that are well advanced and that under normal conditions undergo very little division may respond to the stimulation, divide and grow rapidly.

(6) Galls of indefinite and irregular form and structure may arise from older tissues which still retain some meristematic power. This appears to depend somewhat on the age and activity of the meristematic tissue.

(7) Galls may be classified in one of two groups regardless of the causal organism. The kataplasma group consists of galls which are made up of parenchyma tissue. In the prosoplasma group, the tissues have reached varying degrees of differentiation.

(8) Complex galls, such as those due to the Cynipidæ, always arise from very young and very active meristematic tissue.

(9) Galls of complex structure pass through the stages found in the galls of less complexity.

(10) Insect galls have by far the greatest regularity of structure and development. Some of them are very simple while others present the highest development and greatest complexity of any of the plant galls.

(11) The most complex insect galls show four stages of growth; others pass through one, two or three stages of development.

(12) The organism causing the insect gall is stationary but in the case of most other galls the causal organism may pass by processes of growth or otherwise to points other than their original location.

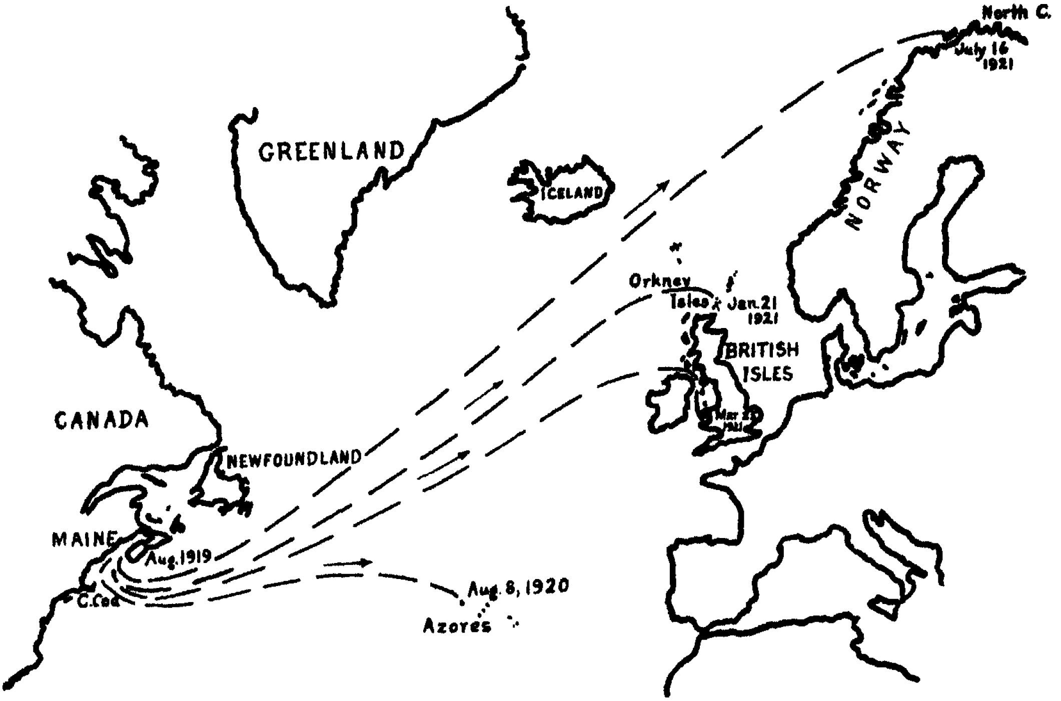

FIGURE 1. Chart on Mercator's projection of the positions of setting out and finding of drift bottles in the North Atlantic, 1919-21.

(13) The stimulus in all cases may pass beyond the location of the causal organism.

(14) Abnormal shoots and other growths (sometimes referred to as embryomas) are frequently formed in connection with many galls. Their status can not be determined from our present knowledge of the subject.

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NEW BRUNSWICK, N. J.

THE COURSE OF THE GULF STREAM IN 1919-21 AS SHOWN BY DRIFT BOTTLES

IN several short notes published in this journal,[1] the writer has recorded the results of drift bottle experiments conducted for the Biological Board of Canada. Since the publication of these notes additional data has been obtained and it seems advisable to bring together to date that part of the data which bears on the course and rate of flow of the North Atlantic Wind Drift, the so-called Gulf Stream.

During the summer of 1919 some four hundred bottles were set adrift in the Bay of Fundy. Each bottle contained a postcard offering a reward to the finder who wrote in the spaces provided on the card the answers to the questions, "Where found? When found? By whom found?" Up to the present time no records have been received of bottles being found south of the Cape Cod peninsula. The records of the seventy-three bottles which were found on this side of the Atlantic during the year 1919 have already been published[2]. Four of the bottles have been found on the European side of the Atlantic. They were set adrift in the latter part of August, 1919, and the records of the finding of them follow:

No. 198. Azores, Island of Flores, August 8, 1920.

No. 230. Orkney Islands, Island of Papa Westray, January 21, 1921.

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[1] Science, N. S., Vol. LII, No. 1349, page 442, November 5, 1920, Vol. LIII, No. 1365, page 187, February 25, 1921, Vol. LIII, No. 1373, page 289, April 22.

[2] Proceedings of the American Fisheries Society, 1920, page 334. Contributions to Canadian Biology, New Series, Vol. I, No. 8, page 103, 1922.

No. 98. Great Britain, Dyffryn, North Wales, March 25, 1921.

No. 129. Norway, two miles from land at the Böhle-Walstation, Sorö, Westfinmark, July 16, 1921.

The places referred to are shown in the accompanying chart, figure 1.

Considerable information as to the course and rate of flow of the North Atlantic Wind Drift or Gulf Stream during the winter of 1919-20 and the summer of 1920 is to be obtained from the finding of these bottles. The distances which they must have been carried, measured along the shortest courses which they could have taken, are approximately 2000, 2800, 2900 and 3800 geographical miles. The corresponding lengths of time which the bottles were "out" are 12, 17, 19, 23 months respectively. This close correspondence between the distances traveled and the times the bottles were "out" indicates that the bottles were picked up relatively soon after they reached the coast. If this assumption is justified the average rates at which the bottles moved across the North Atlantic were 5.8, 5.4, 5.1, and 5.5 geographical miles per day.

The success of this experiment carried out on a comparatively small scale—only four hundred bottles were used and they were all set out within thirty miles of the shore—indicates that important and far reaching results in the investigation of ocean currents are to be obtained from the use of drift bottles. Such experiments can be carried out at small expense. Since the bottles can be set out from any vessel while under way, practically the total cost of an experiment is that of the bottles and the rewards offered to those who find them.

JAMES W. MAVOR.

UNION COLLEGE.

SCIENTIFIC EVENTS

THE PREPARATION OF STAINING SOLUTIONS

IN the text-books dealing with microscopy and with bacteriology, as well as in the journal literature dealing with these subjects, there are two general types of stain formulæ. In one type of formula so much dry stain in weight per given volume of solution is called for, in the other type so many cubic centimeters of a saturated solution of the stain. It will be readily seen that the same staining formula could be prepared by both methods provided the solubility of the dry stain and its actual dye content were known. If all batches of dry stain contained the same amount of actual dye either sort of formula would be perfectly satisfactory.

Unfortunately, however, different lots of any stain vary greatly in the amount of inert material they contain. This is true even in regard to different batches of Grübler stains and it is especially true now when there are so many different brands of stains on the market. An investigation of certain methylen blues, for example, showed a Grübler sample examined to contain 57 per cent. of actual dye, a Merck sample 55 per cent., while five different American samples varied from 69 per cent. to 88 per cent. It seems in general desirable that the color strength should be as high as reasonably possible, and it must be particularly pointed out that the sample containing 88 per cent dye proved one of the two very best in a long series of methylen blues examined. It is obvious, however, that a staining formula calling for so many grams of Grübler methylen blue will be more concentrated if made up with one of these American stains. Considering how these stains vary in actual dye strength, much more nearly constant formulæ can be obtained provided they are prepared on the basis of a definite volume of a saturated solution. Although there are undoubtedly some differences in the amount of actual dye and goes into solution in the case of different brands of stains, nevertheless the results are much more constant in this case than when the formulæ are prepared on the basis of weight of dry dye. For this reason biologists publishing stain formulæ are urged to cooperate with the committee in putting the formulæ on the basis of so many cubic centimeters of saturated solution. The saturated solution may be either aqueous or alcoholic, according to the needs of the individual case. Objections are sometimes made to this type of formula in that it is difficult to prepare without waste when the solubility of a stain is not known. This is not a valid objection, however, because a saturated solution of any stain can always be kept on hand with an excess of undissolved material at the bottom of the bottle, adding more water or alcohol from time to time as more stock solution is needed in preparing staining solutions. This type of formula, therefore, has so many advantages without serious disadvantages that its use is recommended in all possible cases.

H. J. CONN,
Chairman, Commission on the Standardization of Biological Stains

SYMPOSIUM ON MATERIALS OF CHEMICAL EQUIPMENT CONSTRUCTION

MANY prominent chemists have suggested from time to time that a symposium should be held upon the subject relating to materials as applied to construction and equipment in the industry. Therefore, at the spring meeting of the American Chemical Society, it has been decided to hold a symposium entitled "Materials of Chemical Equipment Construction."

The literature upon this subject is so widely scattered and published in many journals inaccessible to the average chemist that in many cases much time must be spent in duplicating work which has already been done. The symposium will tend to bring together such matter for which chemists are constantly in search.

The officers of the Industrial Division have been particularly fortunate in securing Mr. Philip A. Singer, of the Singer-Perlstein Company, Chicago, Ill., to act as chairman of this symposium. Mr. Singer was graduated from Bradley Technical Institute in 1899 and then he pursued graduate work at the University of Heidelberg, Germany. He then returned to this country as chemist for the Glucose Sugar Refining Company, now the Corn Products Company, and became their plant manager and superintendent. Later he became manager of the Standard Alcohol Company, of Fullerton, La. A few years later he became superintendent of the Piel Brothers Starch Works at Indianapolis. While in the last two positions he was also employed in a consulting capacity by the Chicago Starch Works and the Industrial Chemical Institute of Milwaukee. For the last seven years he has been a consulting engineer on the subject of starches, dextrin, glucose and allied subjects. Mr. Singer not only does the engineering work, that is, designs the complete plant, but also superintends the construction and actually operates the plant until it has been put on a practical operating basis.

The subject matter of the symposium will cover woods, metals, vitreous materials, coatings, rubber fabrics, etc. All of these headings will deal with the resisting properties of acids and alkalies, their resistance to temperature, oxidation characteristics, cost, chemical composition, etc.

It is hoped that industrial chemists and university professors will cooperate in every possible way with Mr. Singer by writing to him directly, stating on what phase of the subject they would be glad to present papers at the New Haven meeting.

ERLE M. BILLINGS,
Secretary Industrial Division

TEN-YEAR PROGRAM OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION

IN order that the New York Agricultural Experiment Station may serve satisfactorily the agricultural interests of the state and nation, Dr. R. W. Thatcher, director of the station, and his associates have formulated a program for the development of the work at Geneva for the next ten years. The program has been endorsed by all the organized agricultural agencies of the state and is to be presented to Governor-elect Smith and the new legislature for their consideration. It is believed that only with the aid of a definite program can funds be intelligently appropriated for the work of the station and the affairs of the institution satisfactorily administered. The program provides for the further development of present lines of research and for the inauguration of several new lines of work not now receiving attention.

Activities which the station authorities are anxious to develop further or to undertake as new projects are the breeding and testing of new varieties of small fruits and vegetables, particularly for canning; investigations into the manufacture and preservation of fruit juices, drying of fruits and vegetables, and the utilization of cull fruits and vegetables for jellies, glues and coloring matters; chemical and bacteriological studies of milk and its products; soil tillage studies with special reference to the movement and utilization of soil moisture; studies in plant physiology; investigation of the effect of climatic factors upon plant growth; and careful observations on the relation of birds to agriculture. It is also hoped to study further the efficient use of farm crops for both human and animal food.

"It is not expected to put all of this program into effect at any one time, but to develop it gradually as circumstances permit," says Dr. Thatcher. "The first consideration in carrying out the program, however, is increased laboratory space, as the present laboratories are already overcrowded and will not permit of any expansion of the work. The immediate provision of a new laboratory building is essential if the research work of the station is to progress as it should. The people of the state are asked to back a campaign in the legislature for this building and program, because it is certain that the necessary expenditure will be returned to the state many times over in the increased wealth and prosperity of its agricultural population."

THE CENTENARY OF PASTEUR'S BIRTH

FRANCE'S homage to Louis Pasteur, on the occasion of the centenary of his birth, began on December 24 with a ceremony in the Pasteur Institute. Delegations from scientific bodies, headed by Dr. Pierre Roux and Dr. A. C. Calmette, of the Pasteur Institute, marched in procession before the tomb of Pasteur, which is a crypt in the institute. Afterward Dr. Pozerski of the institute delivered a lecture on Pasteur's life and work.

On December 26 the centenary was observed by the Paris Academy of Medicine, when addresses were made by Professor Behal, president of the academy, and Dr. Calmette, of the Pasteur Institute.

Numerous celebrations were held in France and throughout the world on December 27. Cardinal Dubois celebrated mass in the Paris church where Pasteur worshipped. Pasteur's daughter, Mrs. Valery Radot, and her husband and son were present. President Millerand presided over a memorial ceremony at the Pasteur Institute, where Dr. Pierre Roux, director of the institute, delivered the address.

In this country there were special exercises in Philadelphia on December 27, the principal addresses being made by Ambassador Jusserand and Dr. Hugh S. Cumming, surgeon-general, U. S. Public Health Service. Messages of appreciation were read from President Harding, Mr. Wilson, Chief Justice Taft and many others.

At the American Museum of Natural History in New York there was a meeting at which Dr. George F. Kunz, president of the New York Mineralogical Club, presided. The speakers were M. Gaston Liebert, French consul general; Dr. Henry Fairfield Osborn, president of the American Museum of Natural History; Dr. Hermann M. Biggs, state health commissioner; Dr. George D. Stewart, president of the New York Academy of Medicine; Dr. Pierre Lecomte du Nouy and Dr. Hideyo Noguchi, of the Rockefeller Institute; Major Henry J. Nichols, United States Army, and Professor C.-E. A. Winslow, of Yale University.

The Federation of American Societies for Experimental Biology, meeting at Toronto, arranged a dinner at which addresses were given by Professor Graham Lusk, of the Cornell Medical School, and Professor F. G. Novy, of the University of Michigan.

The centenary is being celebrated by the New Academy of Medicine. A public exhibition which opened on December 27 will continue until January 10. It includes books, portraits, statues, medallions and other objects intimately connected with Pasteur and his work. Commemorative exercises will be conducted in the Academy of Medicine on the evening of January 10.

SCIENTIFIC NOTES AND NEWS

A SPECIAL number of SCIENCE containing the address of the retiring president of the American Association for the Advancement of Science and the proceedings of the association, of the sections and of the affiliated national scientific societies meeting at Boston during convocation week will be issued next week, or as soon thereafter as the material can be collected and edited by the permanent secretary of the association.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution and president of the National Academy of Sciences, formerly director of the United States Geological Survey, has been elected president of the American Association for the Advancement of Science.

PROFESSOR B. M. DUGGAR, of Washington University, has been elected president of the Botanical Society of America; Dr. J. R. Schramm, of the division of biology of the National Research Council, vice-president; Professor I. F. Lewis, of the University of Virginia, secretary, and Professor I. W. Bailey, of Harvard University and the Bussey Institution, treasurer.

PROFESSOR T. D. A. COCKERELL, of the University of Colorado, was elected president of the Entomological Society of America at the Boston meeting. Professor William S. Marshall, of the University of Wisconsin, was chosen first vice-president; F. E. Lutz, of the American Museum of Natural History, New York City, second vice-president; C. L. Metcalf, of the University of Illinois, secretary-treasurer; and Professor Herbert Osborn, of the Ohio State University, managing editor of the annals.

AT the meeting of the American Psychological Association held at Harvard University last week, Professor Lewis M. Terman, of Stanford University, was elected president and Dr. John E. Anderson, of the Johns Hopkins University, secretary.

THE government of Japan has granted to Dr. David Starr Jordan the decoration of the "Order of the Rising Sun with a double series of rays" as "an expression of the nation's recognition and gratitude for the useful and unselfish services rendered for its sake." The decoration was presented through President Kozai and Professor Watasè of the Imperial University of Tokyo.

A DINNER in honor of Professor E. L. Mark, of Harvard University, who was seventy-five years old last May, and was recently retired with the title of Hersey professor of anatomy, emeritus, was given in Boston on December 27.

FRIENDS of Professor Charles Frederick Chandler, of Columbia University, presented in 1910 to the university a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and a medal to be presented to the lecturer in recognition of his achievements in science. The lecturer this year is Robert Eckles Swain, professor of chemistry and head of the department of chemistry of Stanford University, who will speak in Havemeyer Hall on "Atmospheric pollution by industrial wastes" on January 9.

DR. PERCY BROWN, roentgenologist at the Jackson Clinic, Madison, Wis., was awarded the gold medal of the Roentgenological Society of North America at its recent meeting in Detroit. Dr. Brown was formerly president of the society and received the medal because of his distinguished scientific research in X-ray diagnosis and therapy. The medal has been awarded to Madame Curie, of Paris; Dr. Gosta Forsell, of Stockholm, and Dr. Maude Slye, of Chicago.

SIR WILLIAM H. BRAGG, Quain professor of physics in the University of London, has been elected a corresponding member of the Paris Academy of Sciences in the section of physics.

SIR SIDNEY F. HARMER, director of the natural history departments of the British Museum, has been elected an honorary fellow of King's College, Cambridge.

THE Italo-American Association of Rome gave a farewell reception on December 21 in honor of William Marconi, who left on December 22 for the United States. The reception also was in celebration of the twentieth anniversary of the uniting of the United States and Europe by wireless telegraphy. Senator Maggiorno Ferraris made an address of welcome, to which Mr. Marconi responded, saying that his association with the United States had been close and continuous from the time of the commencement of his work on radio telegraphy.

THE war department awarded on December 5 the distinguished service medal to Joaquin E. Zanetti, lieutenant colonel of the Chemical Warfare Service, U. S. A, "for exceptionally meritorious and distinguished services as chief liaison officer of the Chemical Warfare Service with the French forces. His untiring energy, thorough familiarity with the French language and methods and his superior technical ability enabled him to gather an enormous amount of detailed information concerning the manufacture, handling and use of gases, which were of inestimable value to our government in the manufacture and supply of chemical warfare materials in the United States." The presentation was made by Major General Bullard at Governor's Island, N. Y., on December 21.

The friends of Amos W. Butler on December 20 in Indianapolis tendered him a dinner to celebrate his notable success during twenty-five years as secretary of the State Board of Charities. About two hundred and fifty were in attendance. Addresses were made by Governor Warren T. McCray, Dean C. H. Eigenmann, Dr. S. E. Smith, Dean Stanley Coulter and Alexander Johnson, first secretary of the Indiana Board of State Charities. Mr. Butler organized the Brookville Society of Natural History, which in 1885 gave birth to the Indiana Academy of Science, of which he was for many years the executive secretary and president. He has been an active member of other Indiana associations and is at present president of the Indiana Historical Society.

At the annual meeting of the Academy of Natural Sciences of Philadelphia held December 19, John Cadwalader, LL.D., retired from the presidency, which he had occupied since 1918. The following officers, councilors and elective committees were elected to serve for the year 1923: *President,* Richard A. F. Penrose, Jr., Ph.D.; *vice-presidents,* Edwin G. Conklin, Ph.D., Henry Skinner, M.D., Sc.D.; *recording secretary,* James A. G. Rehn; *corresponding secretary,* J. Percy Moore, Ph.D.; *treasurer,* George Vaux, Jr.; *librarian,* Spencer Trotter, M.D.; *curators,* Witmer Stone, Sc.D., Henry A. Pilsbry, Sc.D., George L. Harrison, Jr., T. Chalkley Palmer; *councilors to serve three years,* John Cadwalader, LL.D., Robert G. LeConte, M.D., Milton J. Greenman, M.D., Morgan Hebard; *councilors to serve unexpired terms,* Thomas S. Gates, Henry Tucker, M.D.; *committee on accounts,* Roswell C. Williams, Jr., Samuel N. Rhoads, John G. Rothermel, Thomas S. Stewart, M.D., Walter Horstmann.

At the annual meeting of the American Social Hygiene Association, held in New York on November 3, under the presidency of Dr. Hermann M. Biggs, the following officers were elected for the ensuing year: *President,* Dr. Hermann M. Biggs, New York City; *vice-presidents,* Drs. Ray Lyman Wilbur, San Francisco, Dr. William S. Keller, Cincinnati, Dr. William A. Evans, Chicago, and Mrs. Joseph T. Bowen; *secretary,* Dr. Donald R. Hooker, of the Johns Hopkins University. It was announced that the *Journal of Social Hygiene* will appear, January, 1923, as a monthly, the new publication taking the place of the *Social Hygiene Bulletin.* Professor Maurice A. Bigelow, of Teachers College, Columbia University, is editor-in-chief of the new journal.

Professor O. F. Stafford, head of the department of chemistry of the University of Oregon, has returned to his university work at Eugene, after a leave of absence of four years' duration devoted to industrial research in the field of waste wood utilization by destructive distillation.

Carl G. Schluederberg, president of the American Electrochemical Society, left recently for a four months' trip in the Orient to study business conditions.

Professor H. S. Fawcett, of the Citrus Experiment Station of the University of California, is spending a sabbatical year in southeastern Russia. He is engaged in relief work of the American Friends Committee at Sorochinskya. He expects to return in the summer of 1923.

Dr. Walter Rosenhain, head of the metallurgical department of the British National Physical Laboratory, will visit the eastern United States during February and March, 1923, lecturing before various universities and scientific organizations.

The annual Gross lecture for 1922 of the Pathological Society of Philadelphia has been delivered by Professor Warren H. Lewis, of the Department of Embryology of the Carnegie Institution, on "Pathological changes in cells in tissue cultures."

PROFESSOR JOHN HUNTER, of the University of Sydney, Australia, lectured recently at the Evans Institute of the University of Pennsylvania on "The evolution of the brain in the light of modern discoveries."

PROFESSOR SUMMERFELD is to spend two weeks at the California Institute of Technology beginning January 24. He will deliver eight lectures covering the following topics: Quantic conditions, especially for more than one moving particle; Atomic structure and periodical system; Quantization in space, theory of magneton; Principles of selection in the visible and the X-ray part of the spectrum; Line structure of complicated spectra treated by the method of inner quantic numbers.

BEFORE the Franklin Institute on December 20 Dr. W. F. G. Swann, professor of physics, University of Minnesota, lectured on "Unsolved problems of cosmical physics."

THE fourth Harvey Society lecture which was to have been delivered at the New York Academy of Medicine on January 13, by Dr. William T. Bovie, assistant professor of biophysics, Harvard University, on "The physiological effects of light rays," has been postponed until January 20.

A CONVOCATION commemorative of the births of Mendel and Pasteur was held at St. Louis University on the evening of December 14. After introductory addresses by Chancellor Frederic A. Hall of Washington University and Professor Frederick M. Tisdel, dean of the College of Arts and Sciences of the University of Missouri, who represented President John Carleton Jones, the main addresses of the evening were delivered by Professor H. S. Jennings, on "Mendel, the Scientist," and Professor Victor C. Vaughan, "Pasteur, the Scientist." The exercises were concluded by the presiding officer, President William F. Robison, with an address, "Science and the Man."

WE learn from *Nature* that a memorial window in Westminster Abbey in remembrance of Sir J. W. Wolfe Barry, past president of the Institution of Civil Engineers, was dedicated on December 7 by the dean of Westminster. The window, which is in the nave, contains the figures of two angels holding tablets on which are inscribed the words "In Memory of John Wolfe Barry, K.C.B., F.R.S., Civil Engineer. Born 1836. Died 1918." Below the tablets are shields showing, among others, the arms of the Institution of Civil Engineers, of the University of London, and Sir John Wolfe Barry's personal arms.

A STATUE of Professor Adolf von Baeyer was unveiled in the Botanic Garden of the University of Munich on October 20. Professor Willstätter spoke on behalf of the university, and Dr. Duisberg on behalf of the Association of Dye Manufacturers, Professor Seeliger for the Bavarian Academy of Sciences and Dr. Lepsius for the German Chemical Society.

THE international fund in honor of Lord Lister has been closed, the amount received being sufficient to provide a prize of £2,800 (about $13,000), to be awarded triennially for the most important advancement made in surgery, irrespective of nationality. This prize will be awarded on the anniversary of Lord Lister's birth.

DAVID LINDSAY, the explorer, whose pioneer investigations were in part responsible for the discovery of the great West Australia gold field, died recently in Australia at the age of 66 years.

THE death is announced of Dr. H. Obersteiner, professor emeritus of the physiology and pathology of the central nervous system at the University of Vienna, aged seventy-five years.

AN Associated Press dispatch from Paris states that the first sub-committee of the League of Nations Intellectual Cooperation Commission, presided over by Professor Henri Louis Bergson, which has had under discussion the question of the extension of the rights of scientists so that they may be able to share in the benefits derived from the application of their discoveries, has concluded its work. Professor Ruffini, of Turin University, was commissioned to draft a plan for the legal protection of scientific work. After approval by the commission and the council of the League of Nations the plan would serve as a basis for legislation by parliaments of the different countries of the world.

THE annual general meeting of the American Philosophical Society will be held on April 19, 20 and 21, beginning at 2 P.M. on Thursday. Members are requested to send to the secretaries, at as early a date as practicable and before February 22, 1923, the titles of papers which they intend to present, so that they may be announced in the *preliminary* program which will be issued immediately after that date and which will give in detail the arrangements for the meeting. It is understood that papers offered are original contributions which have not been theretofore presented. The publication committee, under the rules of the society, will arrange for the immediate publication of the papers presented in either the *Proceedings* or the *Transactions*, as may be designated.

THE first regular meeting of the Georgia Academy of Sciences was held at the University of Georgia on December 1 and 2, 1922. Twenty-five members were elected as charter members and fifteen more may be elected during the coming year. Membership in the academy is limited to those residents of Georgia who have made notable contributions to science or to its advancement in the state and can not exceed fifty in number. The officers elected for the first year are: *President*, Dr. R. P. Stephens, mathematics, University of Georgia; *vice-president*, Dr. T. P. Branch, civil engineering, Georgia School of Technology, Atlanta; *secretary-treasurer*, Dr. Henry Fox, biology, Mercer University, Macon.

THE Rochester Section of the American Chemical Society has secured Professor Th. Svedberg, University of Upsala, Sweden, to act as presiding officer of a symposium on physical chemistry which will be held in Rochester on January 19 and 20. Papers will be presented by prominent physical chemists from Schenectady, Cornell, Syracuse, Buffalo and Rochester. Practically every phase of physical chemistry will be dealt with, with the exception of colloids. On this phase there will be no papers since a colloid symposium will be held at the University of Wisconsin later in the year. The Rochester Section extends an invitation to those interested in this physical chemistry symposium to be present and to take part either in the presentation of papers, or in the discussion which will follow the papers.

THE annual meeting of the British Association of Economic Biologists was opened in the Botanical Department of the University of Manchester on December 15. Dr. W. Lawrence Balls introduced a discussion on genetics in relation to applied biology. After dinner there were informal discussions on the place of applied biology in universities and on the relation of biology to medicine. A visit was paid to the British Cotton Industry Research Association at Didsbury.

AN expedition for zoological exploration will be maintained in Honduras and British Honduras by the Field Museum of Natural History in the early months of 1923. Mr. Karl P. Schmidt, assistant curator of reptiles and amphibians, accompanied by Mr. L. L. Walters, taxidermist, will leave New Orleans in January for Belize, British Honduras. After a short stay in the coastal region of British Honduras, in the nature of a reconnaissance, the party will proceed to Honduras, establishing a base at Lake Yojoa, in the interior. Collections of fishes, amphibians, reptiles and mammals will be made in this little known region. The fishes of Lake Yojoa appear to be entirely unknown. It is planned to secure material which will enable the Department of Zoology to prepare specimens and habitat groups for exhibition, representing the rich and varied amphibian and reptile life of Central America.

THE Edible Gelatin Manufacturers of America, Incorporated, announces the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, for the purpose of ascertaining the real food value of edible gelatin in its manifold applications in the American dietary. In addition to experimental investigations, a correlation of available facts regarding edible gelatin will be made, to be held at the disposal of all users. The present incumbent is Dr. Thomas B. Downey, who will be glad to furnish information to those interested in the uses of edible gelatin.

REPRESENTATIVE CABLE, of Ohio, has offered a resolution in the House, requiring the use with immigrants of the "intelligence tests" used by the army. The resolution has the approval of the house committee on immigration, and the indications are that experiments will be made to find out whether the proposed system is superior to the tests now used. The resolution sets forth that intelligence tests have been given to soldiers of the United States during and since the World War; applied by the United States Public Health Service to a limited number of immigrants of doubtful admission; used by the United States in civil service examinations; in schools, colleges and universities in classifying pupils and students; by insurance and other large companies in selecting salesmen; in large industries for classifying men in work most adaptable to them, and by business enterprises in the selection of office forces. Students of the problems relating to immigration have indicated a belief that the standard of immigrants seeking admission to the United States may be raised by the application of the intelligence tests, and the secretary of labor and the surgeon general of the United States Public Health Service have full power and authority to apply such tests. The resolution directs the secretary of labor and the surgeon general of the Public Health Service to inform the House why scientific data, including the intelligence tests, can not be applied in all cases for the exclusion of undesirable immigrants.

UNIVERSITY AND EDUCATIONAL NOTES

The Rockefeller Foundation and the General Education Board have each given $1,250,000 to the College of Medicine of the State University of Iowa. The legislature will be asked to appropriate $2,500,000 at the rate of $450,000 a year for the building and equipment of hospitals and laboratories.

The sum of $50,000 left by the late Charles S. Baylis reverts to the Brooklyn Polytechnic Institute by the death of Mrs. Baylis on November 15.

Dr. Josiah H. Penniman was elected provost, or the "educational or academic head" of the University of Pennsylvania, on December 27. He had been acting provost since the resignation of Dr. Edgar Fahs Smith about three years ago. At the same time the board of trustees created an "executive administrative" office, to be known as the "president of the university." This is the position that it was planned should be filled by General Leonard Wood.

D. W. Morehouse, professor of physics and astronomy at Drake University, has been elected dean of the college of liberal arts.

At Yale University, Dr. Lorande Loss Woodruff, professor of biology, has been elected professor of protozoology.

Dr. Morris S. Kharasch, formerly national research fellow in organic chemistry at the University of Chicago, has been appointed associate professor of organic chemistry at the University of Maryland.

Dr. Richard C. Lord, at one time instructor at Washington and Lee University and later engaged in industrial chemistry, has been elected assistant professor of chemistry and physics at Kenyon College, Gambier, Ohio.

At Dartmouth College, Assistant Professor R. D. Beetle has been promoted to a full professorship of mathematics, and Assistant Professor C. E. Wilder, of Northwestern University, has been appointed to an assistant professorship.

DISCUSSION AND CORRESPONDENCE

THE INDEXING OF BIOLOGICAL LITERATURE

I have been much interested in Dr. Schramm's excellent discussion in Science of November 3, and since the whole subject of abstracting and indexing is up for reconsideration, it may be opportune to add a few remarks from a zoological standpoint.

It may fairly be said that American zoologists do not pay enough attention to the literature of their subject outside of the very narrow field of their specialty. In spite of the broadening tendencies of modern genetic research, we do not seem to be able to escape from a narrowness which sometimes prevents those working on one group from even being aware of the existence of distinguished colleagues specializing in another. Thus it comes about that the development of numerous special journals, necessary as these are, is actually detrimental to zoology as a whole if there is no broader survey of the field which specialists read. Every technical monograph contains material which should be of great interest to *all zoologists,* but such works are published and go to a small number of specialists, frequently with not even a review to call the attention of a wider public. The zoologist is in danger of becoming what the Greeks called *idiotes,* one who lives to himself and has no part in the larger affairs even of zoology.

It is not important to debate whether it was always so, or whether it is so elsewhere in greater degree. The evil is a real one, and should be met in such ways as Dr. Schramm indicates.

It must be said, however, that the fault is more with the zoologists themselves than with the means devised to serve them. The *Zoological Record,* which has been regularly published since 1864, should be a *sine qua non* to every zoologist, yet comparatively few use it. It has been, especially of late, as nearly perfect as a human thing may be. From it, I can learn in half an hour what species of *any* genus of animals have been described, placed in the synonymy, or referred to in important discussions, during say the last twenty years. I can learn what species have been described from Samoa or Spain; what contributions have been made to comparative physiology or anatomy, and in short anything of importance about animals, living or fossil. Personally, I subscribe to the complete volumes; but if I do not wish to do this, I can get the whole account of Protozoa for a year for three shillings, of mollusca for five shillings, of mammals for three, and so forth. Can there be a living student of mammals who will not pay 75 cents a year to have a complete index to the literature of his subject? Incredible as it may seem, there are dozens of them! The one thing the *Zoological Record* does not do, and which should be done, is to provide readable discussions of the literature, pointing out in an interesting way the nature of the advances and estimating their importance. This, however, can not be done efficiently unless the critical element is allowed to enter, unless the discussion becomes a review and not a mere abstract.

Something should be said about the card catalogue. I maintain card catalogues of my own for particular purposes, and they are invaluable. But as a means of ready reference to zoology as a whole, or any large branch of it, cards are miserably inadequate. If I were furnished the whole contents of the *Zoological Record* on cards, I could neither find time to arrange them, nor space to take care of them. Furthermore, suppose the space and assistance provided, I could not use the catalogue with the same advantage. Thus, to ascertain the nature of the references to, say Equidæ, I should have to turn over hundreds of cards. On the pages of the *Record,* my eye runs rapidly over the assembled data, and I can cover the work of a year in a few moments. If I am concerned with some genus, on the printed page I find the related and segregated genera close at hand, and at once perceive or suspect their significance for my researches. With cards, if a species is not placed in the genus I am looking up, I almost certainly miss it altogether.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO,
NOVEMBER 22

SPECIFIC TERMS FOR THE PROTEOLYTIC ACTIVITY OF ANAEROBES

IN descriptions of anærobes the term "proteolytic" is very widely used, and in classification studies this activity of the organism is of very great importance in grouping. In some schemes it is given first consideration because it is a fundamental, deep-seated physiological character. However, the term does not carry a definiteness of meaning commensurate with its importance.

For example, the Medical Research Committee (1919) in their Special Report, Series No. 39,[1] on the classification of anærobes include *C. septique* in the proteolytic group because it liquefies gelatine, while in their Special Report, Series No. 12 (1917),[2] they place it in the non-proteolytic group on the basis of its inability to liquefy blood serum. The use of such a general term as proteolytic tends to confusion and it seemingly would have been better to have made the classification on its ability to liquefy or not liquefy gelatine or its ability to digest blood serum or not to digest it and to have used corresponding specific terms such as gelatinolytic and serolytic.

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[1] Medical Research Committee. 1919 National Health Insurance. Special Report Series, No. 39. Reports of the committee upon anærobic bacteria and infections. London, pp. 182.

[2] Medical Research Committee. 1917 National Health Insurance. Special Report Series, No. 12. The classification and study of the anærobic bacteria of war wounds. London, pp. 74.

Reddish and Rettger[3] (1921) were not satisfied with the general term "proteolytic" to cover digestion of all kinds of protein and made use of this term only with some reservation. They did not designate an anærobe proteolytic on the basis of genatin-liquefying power, but reserved the term "gelatinolytic" for this property; the term "proteolytic" was used to mean the digestion of native proteins only, such as meat, egg-albumen and blood serum. They designate the breaking down of peptone as "peptolytic." It is true that gelatin and peptone are simpler than the native proteins and for that reason, perhaps, more easily attacked, so that the difference in ability of an organism to attack these without being able to digest the native protein may be one of degree and not of kind. It seems more probable, however, that it is really a difference in kind of enzyme.

It seems to the writers that specific terms should be used throughout in describing such properties of anærobes, or of any other bacteria. Since various kinds of protein are used, it might be well to use designations to fit those employed. Such terms as the following would find a place in these descriptions: sarcolytic (dissolution of flesh); peptolytic (dissolution of peptone); gelatinolytic (dissolution of gelatin); ovolytic (dissolution of egg albumen); fibrinolytic (dissolution of fibrin); etc. In no sense is the term "proteolytic" to be limited, except that it should be qualified by such of the above terms as suit the case. It might even be advisable to base classification grouping upon one or another of the specific kinds of protein used. For this purpose, meat seems to offer the greatest promise, because of the ease with which meat media can be prepared, the simplicity of the use of same, and the standard nature of the medium in anærobic work. If this were adopted, anærobes could then be designated "sarcolytic" or "non-sarcolytic," according to whether or not meat is digested. At least, such a division on the basis of specific protein attacked would be more in keeping with the scientific accuracy which is the goal in all fields of bacteriology. In medicine, the use of specific terms has been necessary to avoid complications in meaning. This should prove equally valuable in bacteriology.

E. C. L. MILLER

G. F. REDDISH

MEDICAL COLLEGE OF VIRGINIA

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[3] Reddish, G. F., and Rettger, L. F.: 1921 Proc. Soc. Amer. Bact., 23rd Ann. Meeting, Philadelphia, 1921.

THE STANDARDIZATION OF BIOLOGICAL STAINS

SPECIAL attention of biologists is called to the fact that the work on standardization of stains is no longer being carried on by the National Research Council. It is a fixed policy of the council to take part in the stimulation and assistance of scientific projects in their initial stages, but to withdraw when such projects are well started in order to be able to respond to new desirable projects brought before it. For this reason it has now withdrawn from the work that is being done on stains, not because it is no longer interested in the project but because the work is now in a position to justify an independent existence.

With the assistance of the council, an independent commission has been formed composed of an indefinite number of the biologists who have been collaborating in the work. At present about sixty investigators are members of the commission. Its affairs are managed by an executive committee composed of H. J. Conn, J. A. Ambler, S. I. Kornhauser, F. W. Mallory and L. W. Sharp.

The present occasion is taken to call attention to an omission in a recent paper referring to this work.[1] In this paper the name of one concern specializing in biological stains was inadvertently omitted. This concern was formerly known as the H. S. Laboratories, and has just been reorganized under the name of the Hartman-Leddon Company; its address is 6005 Girard Avenue, Philadelphia, Pa. Apologies are due to the company for the unintentional omission.

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[1] "Present Supply of Biological Stains," SCIENCE, 56, No. 1455, pp. 562-3.

H. J. CONN,
Chairman Executive Committee,
Commission on Standardization of
Biological Stains

GENEVA, N. Y.
DECEMBER 1, 1922

QUOTATIONS

THE ROYAL SOCIETY

YESTERDAY being St. Andrew's Day, the fellows of the Royal Society, in accordance with their custom and duty since the middle of the seventeenth century, assembled to elect their officers and council for the ensuing year. Thereafter, in accordance with a custom more ancient than the formal granting of their charter, they reassembled in a tavern to "make merry with persons of consequence in the community." Long may it flourish and increase its influence on the affairs of the community, directly or through persons of consequence. It may be doubted if the election of fifteen new fellows annually, a wise restriction when the number was thus determined in 1847, is now sufficient, if the extension of science and of the empire since that date be considered. But it can not be doubted that the anxious care given to the selection of candidates has made the fellowship a real distinction, and the society the foremost representation of scientific opinion in the world. The more the pity that it does not use so fine a voice to its due capacity. The Royal Society should be the acknowledged adviser of the government, of the departments and of the nation on all scientific and in many educational matters. It should receive, allot and administer all state aid for scientific research and for higher scientific education. It should be the obvious channel into which private benefactions for scientific objects should be directed. In fact, the direct contacts of the Royal Society with government, with departments and with universities, have diminished rather than increased in recent years, and generous private benefactors have less often chosen it as the vehicle of their wishes. The officers and council elected yesterday are men of the highest distinction; let it be hoped that they will take steps towards re-acquiring and increasing the direct influence and authority of the chief scientific body in the empire.—The London *Times.*

A PSYCHOLOGICAL CORPORATION

A "CORPORATION owned entirely by 166 psychologists!" Such a body gives at first a suggestion of unpracticality that would hardly recommend their stock to speculators on the market. For psychologists have to do not with objective substances but with the behavior of the mind—its origin, its powers and its functions. Yet this factor is really vital to every business, and the larger this human factor, the more practical the psychologist's part becomes. In this sense, these 166 psychologist stockholders are pragmatic people and not business mystics. In this distinguished directorate are such men as President Angell, Dr. G. Stanley Hall, Professor Thorndike and Dr. Cattell—the latter the president of the corporation.

The "heaven sprung message of the olden time" was, "Know thyself." It is now becoming not only the adage of the life insurance companies, of the life-prolonging institutions and of the schools, colleges and universities, but also the motto of business. Intelligence tests are the order of the day. Vague, good-natured letters of recommendation are no longer the open sesame to responsible positions. What civil service examinations have attempted to do for the public business this psychological corporation is to undertake by the application of psychological tests to those who wish to enter private business. Such independent tests made by competent disinterested experts should be of great value in determining certain kinds of fitness, which under the ordinary methods of selection are discovered usually with loss of time and wasteful experience.

William James used to say that the chief value of a college education was to enable you to know a good man when you saw one. But even if this power of discrimination were conferred with a bachelor's degree, it would not be sufficiently discerning to detect technical fitness or even professional intelligence. The psychologists aim to be brought in as appraisers and not as prophets.—The New York *Times.*

SPECIAL ARTICLES

THE MODE OF REACTION OF HIGHLY INSOLUBLE OR UNDISSOCIATED SALTS

THE interesting note by Professor Smith[1] on the precipitation of metals by hydrogen sulfide has served to call again attention to our inability to explain the precipitation and reaction of highly insoluble or undissociated salts on the basis of reaction between simple ions. A result of the famous discussion of Haber[2], Bodländer[3], Abegg *et al.*, on the interpretation and consequences of the electrometric measurements of Bodländer on the silver cyanide complexes was the conclusion reached by him that in such cases the reaction is between the precipitating ion and the complex ion rather than with one of the ions into which the complex ion dissociates. Thus he proposed writing the reaction between potassium argentocyanide solution and sodium sulfide as

$$2Ag(\overline{CN})_2 + \overline{\overline{S}} = Ag_2S + 4\overline{CN}$$

rather than

$$2\overset{+}{Ag} + \overline{\overline{S}} = Ag_2S.$$

The necessity of an explanation such as proposed by Bodländer or Smith becomes apparent from several reactions of mercuric sulfide and mercuric cyanide. In the case of mercuric sulfide one finds that there is present but one mercury and but one sulfide ion in 1,000 liters, or 10^{-5} of an ion in 10 c.c. of solution. If we assume with Haber that the minimum time that an ion remains free is 10^{-18} second, it follows that at minimum intervals of 10^{-13} second, a Hg- and a S-ion flash through the solution. Yet if we have several grams of mercuric sulfide in 10 c.c. of water, addition of a KI solution of iodine will bring the mercury into solution as rapidly as it is added. The reaction in other words goes on billions of times as fast as can be predicted even on the implied assumption of Haber that electrons are transferred between atoms with a velocity of light (3×10^{-8} cm. being taken as the order of magnitude of the atom, and 3×10^{10} cm. is the velocity of light, or 10^{-18} second is the time of transfer of an electron or minimum time of existence of an ion according to Haber). It would therefore appear that the aforementioned reaction should also be considered as a reaction between the iodine and the molecules of mercuric sulfide on the surfaces of the precipitate as well as with any mercuric sulfide or hydrosulfide molecules momentarily present in solution.

Another interesting instance is the precipitation of mercuric sulfide by the addition of sodium sulfide to a solution 0.1 M. with respect to $Hg(CN)_2$ and 1 M. with respect to KCN. From the dissociation value of 10^{-41} found by Sherrill[4] for the $Hg(CN)_4$ complexion, it can be figured on the same assumptions as made above that in 10 c.c. of such a solution one Hg-ion flashes through the solution at minimum intervals of 10 seconds. Yet *precipitation* takes place rapidly.

Since the atomic theory is much more firmly intrenched now than it was at the time when Haber first raised the question as to the character of reactions of highly insoluble or slightly dissociated substances, we must disregard his first supposition that the atomic theory may be in error, and accept as a logical explanation his second supposition that molecules and complex ions take part in such reactions.

BENJAMIN S. NEUHAUSEN
THE PHYSIOLOGICAL LABORATORY,
THE JOHNS HOPKINS UNIVERSITY

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[1] *J. Am. Chem. Soc.*, 44, 1500 (1922).

[2] *Zeit. f. Elektrochem.*, 10, 433, 738 (1904).

[3] *Ibid.*, 10, 604 (1904).

[4] *Zeit. f. phys. Chem.*, 43, 717, 735 (1903).

THE MUSCH RAIN-CORRECTING MOUNTING FOR POROUS PORCELAIN ATMOMETERS[1]

Two years ago Livingston and Thone[2] described "A simplified non-absorbing mounting for porous porcelain atmometers" which, by reason of its simplicity of construction and operation as well as its inexpensiveness, has since come into very general use. The essential feature of this mounting is a short column of mercury placed near the upper end of the straight glass feed-tube which connects the atmometer above with the water reservoir below. This column of mercury, held in place by two plugs of glass wool (one above and the other below), acts very effectively as a valve to prevent the passage of water from the atmometer down the tube into the reservoir, at the same time having no effect whatever on the passage of water up the tube to replace that lost by evaporation.

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[1] Contribution from the Osborn Botanical Laboratory.

[2] SCIENCE, N. S., 52: 85-87, 1920.

Notwithstanding the obvious advantages of the Livingston-Thone mounting, there are certain objectionable features attendant upon its use which can not be overlooked. To begin with, the mercury valve with its glass wool plugs has to be properly constructed every time it is needed for use: once a season at any rate. Again, in sucking water through the tube, during the setting up of the apparatus, there is danger of drawing slivers of glass wool into the mouth. But perhaps the most serious objection has to do with the accumulation of air-bubbles in the atmometer or in connection with the glass wool plugs. It is impossible to detect bubbles in the atmometer except by taking the whole apparatus to pieces, while a bubble in the tube may sometimes become so large as to endanger the continuity of the water column.

The device to be described below was designed by Mr. Frederick Musch of New Haven as a result of experience in operating a series of porcelain atmometers for Dr. Norman Taylor—instruments equipped with the Livingston-Thone mounting. Like the latter,[3] the Musch mounting depends on a mercury valve to prevent the absorption of water, but here the resemblance ceases. The Musch device (Fig. 1, *A*) consists primarily of a J-shaped glass feed-tube, the straight end of which (*a*) extends up through the stopper of the reservoir while the curved end (*c*) passes down into the reservoir, reaching to within about half an inch of the bottom when in place. The atmometer is of course attached to the upper end of the tube, and a column of mercury (*Hg*) in the curve at the bottom of the J forms the valve. The short arm of the J is long enough to prevent the mercury splashing or being forced out of the tube into the bottle. A second important feature consists in a short side-arm (*b*), attached to the tube about an inch and a half above the bottom of the J and extending outward and upward. The outside width of the J and the outside distance between arm and tube are gauged to insure their easy insertion through the neck of the reservoir bottle. The side arm is attached at a point just high enough above the curve of the J to permit the latter to clear the bottom of the neck, while inserting, before the arm strikes the top. The side arm is long enough so that the straight part of it more than holds the mercury column, when desired, and at the same time short enough so that when in position it lies about half an inch below the shoulder of the reservoir bottle. The proper dimensions can readily be ascertained by the use of a cardboard model and a bottle of the type it is intended to use as the reservoir. The glass tubing should be of sufficiently large bore to permit the ready passage of large air bubbles.

In setting up the apparatus the feed tube is first shoved through the reservoir stopper from below and the atmometer stopper affixed to its upper end in the usual way. Next, enough mercury is placed in the crook at the bottom of the tube to completely block the passage. The whole thing is then carefully turned upside down, in such a way that the mercury column runs out of the J and into the side-arm. With mercury and tube in this position the atmometer, filled with water, is attached (or it can be attached empty and then filled either by suction or in the manner described below). The mount with attached atmometer is then turned right side up, the mercury resuming its

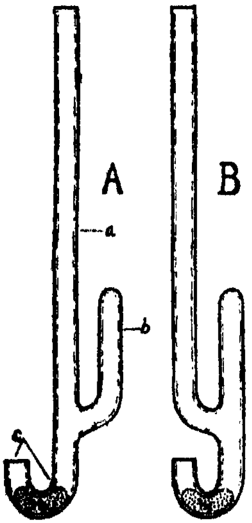

FIG. 1

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[3] And like several others that had been described previously: see references in SCIENCE, 52, p. 86 (1920).

position in the crook of the J, the feed-tube is lowered into the reservoir, and the stopper is forced home. The filling of atmometer and tube is completed by turning the whole apparatus upside down and then alternately back and forth, in a manner which a little experimentation will readily suggest, due precautions being taken during this operation that the mercury retains its position in the side-arm. This same simple expedient is adopted at any time when it is desired to ascertain whether air bubbles are present in the atmometer and for getting rid of them. Any difficulty in persuading air bubbles to emerge from the atmometer into the feed-tube can be overcome by tapping the base of the instrument or by variously shaking the whole apparatus.

The Musch atmometer mounting has been thoroughly tested under various conditions, both by the writer and by others. It has already been adopted by several investigators for field work during the past season and appears to have given uniformly satisfactory results. The chief objection to which it may be open seems to be this: that during a heavy or protracted rain (or when left under a tap) there may be an initial absorption of water from without amounting to as much as 0.6 cc.[4] This absorption is due to the fact that the mercury valve does not remain stationary before the downward-pressing water column but retreats a short distance up into the short arm of the J. During a period when the weather at relatively brief intervals is alternately wet and dry it is conceivable that an error of several cc. might be introduced by the intermittent fluctuation back and forth of the mercury column; but ordinarily the error would be relatively inconsequential and could be corrected with reasonable accuracy if desired. The most obvious advantages of this style of mounting are (1) that it is possible to detect the presence of air bubbles in the atmometer by simply turning the whole apparatus upside down, and to get rid of them without even taking the cork out of the reservoir bottle; (2) that bubbles can not accumulate in the feed-tube; (3) that any objections which may arise from the use of glass wool are eliminated; and (4) that the mounting is always ready for immediate use. The contrivance can readily be made by any one adept at glass-working or it can be secured from at least one dealer in apparatus and supplies for about fifty cents.

In conclusion, brief attention is called to a modification of the Musch mounting which has been devised by Dr. F. C. Gates (see Fig. 1, *B*). This modified model recommends itself in being somewhat easier to construct and somewhat more compact and also in the fact that the mercury runs more readily back and forth between arm and valve curve than in the original model. This latter feature, however, while of advantage in some respects, may prove a disadvantage when it comes to the rapid filling of atmometer and mount, except where this is done under water (the practise followed by Dr. Gates) or by the suction method: the replacement of long air columns and large bubbles of air is interfered with by the very ease with which the mercury slides back and forth.

G. E. Nichols

Yale University

THE INDIANA ACADEMY OF SCIENCE

The Indiana Academy of Science held its thirty-eighth annual meeting at Hotel Lincoln, Indianapolis, on Thursday and Friday, December 7 and 8, 1922. The officers of this meeting were as follows:

F. M. Andrews, Bloomington, *President.*
C. A. Behrens, LaFayette, *Vice-president.*
W. N. Hess, Greencastle, *Secretary.*
H. F. Dietz, Indianapolis, *Assistant Secretary.*
W. M. Blanchard, Greencastle, *Treasurer.*
F. Payne, Bloomington, *Editor.*
F. B. Wade, Indianapolis, *Press Secretary.*

The meeting was unusually well attended and the program presented was as follows:

GENERAL SESSION

Estimating the wealth of Indiana as compared with other states. Stephen S. Visher, Indiana University.

A photographic study of architectural acoustics. Arthur L. Foley.

Francis Galton, life and work. Robert Hessler.

Paleolithic Stone Age in Indiana. S. Frank Balcom.

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[4] The amount of absorption may be greater if too short a column of mercury is used.

The archeological survey of Jefferson County. Glenn Culbertson.

The smog problem. Robert Hessler.

Life and mind. Robert W. McBride.

Frank B. Wynn: In memoriam. Robert W. McBride.

Alexander Smith: In memoriam. R. E. Lyons.

Address of the retiring president: Some problems of plant physiology. Frank M. Andrews.

Earl Jerome Grimes: In memoriam. Harry F. Dietz.

The scientific work of the conservation commission. By title. Stanley Coulter.

The southern Ute Indians of the Pine River Valley, Colorado. By title. Albert B. Reagan.

Indian funerals. By title. Albert B. Reagan.

Twinkling star. By title. Albert B. Reagan.

SECTIONAL PROGRAM

Geology and Geography

History of the lakes near Laporte, Indiana. William Motier Tucker.

Mineral resources of Indiana. W. N. Logan, Indiana University.

Goniobasis livescens Menke, a pleistocene shell in Furnassville Blowout, dunes of Porter County. Marcus W. Lyon, Jr.

Valley-heads and sheet-wash erosion. Clyde A. Malott.

The rôle of sheet-wash in erosion. Clyde A. Malott.

A Pennsylvania scorpion from Clay County, Indiana, with notes on its relationship and geological significance. By title. John Irvin Moore.

Some contrasts among the geographic subdivisions of Indiana. Stephen S. Visher.

Abandoned channels in Randolph and Delaware Counties, Indiana. Frederick J. Breeze.

The Muncie esker. Frederick J. Breeze.

The entrenched meanders and associated terraces in the Muscatatuck River, near Vernon, Indiana. Burton J. Malott. Indianapolis.

A new pleistocene gastropod from Maryland. By title. Ernest Rice Smith.

Archeology in Posey and Vanderburg Counties (Indiana). Andrew J. Bigney.

PHYSICS AND CHEMISTRY

Chemistry

Qualitative analysis—tin group. Ralph W. Hufferd.

Qualitative analysis—iron group. Ralph W. Hufferd.

The normal system in quantitative analysis. E. G. Mahin.

The effect of non-metallic impurities on cementite distribution in steel. G. B. Wilson.

Some toxic soils of Indiana. R. H. Carr.

A study of, and a modified method for, Vogel's reaction for cobalt. F. J. Allen and A. R. Middleton.

Thiocyanotocobaltous acid and its alkali salts. F. J. Allen and A. R. Middleton.

Evaporation of solutions in burettes. M. G. Mellon.

The use of solutions of inorganic salts as permanent color standards. M. G. Mellon, Purdue University.

An improved murexide reaction. Samuel E. Earp.

Fog formation in air which has passed through a silent discharge. F. O. Anderegg and K. B. McEachron.

A type of silent discharge involving catalysis. F. O. Anderegg and E. H. Bowers.

A further study of pressure reversals in the corona discharge. F. O. Anderegg.

The peculiar properties of water in reference to its molecular structure. F. O. Anderegg.

Physics

Some untenable acoustic theories. Arthur L. Foley.

Improved designs of sound "condensers." Lantern. Arthur L. Foley.

Locomotive whistle experiments. Arthur L. Foley.

Energy losses in railroad track hammers. Lantern. Edwin Morrison.

Scattering of light by small particles. Edwin Morrison.

Spectrum of phosphorescent mercury. E. K. Chapman.

A method of measuring the amplification of two or more stage amplifiers. R. R. Ramsey.

A method of securing accurate high frequency standard. R. R. Ramsey.

An oscillographic study of an induction coil with high frequency load. F. O. Anderegg and K. B. McEachron.

An investigation of the Foley telephone mouthpiece. James E. Brock.

Diffraction of light through circular openings. Mason E. Hufford.

BIOLOGICAL SCIENCES

Zoology

Some genes modifying crossing-over. F. Payne.

The occurrence of secondary parasitism in frog parasites. By title. George Zebrowski, Purdue University.

Relation of insects to human life and to the natural sciences. John J. Davis.

Content of first course in zoology. R. A.

GANTZ, Indiana State Normal School, Eastern Division.

Notes on mammals of the dune region of Porter County. MARCUS W. LYON, JR.

Notes on the termites of Indiana, II. HARRY F. DIETZ.

A heritable character affecting the blood serum of the guinea pig. By title. ROSCOE R. HYDE, Johns Hopkins University.

Photoreceptors of Lumbricus terrestris. WALTER N. HESS.

The spermatogenesis of the Louisiana earwig. W. P. MORGAN.

A hygrothermograph puzzle. W. H. LARIMER.

A study of the Virginia opossum. W. H. SHEAK.

Bacteriology

Nagana (Trypanosoma Brucei). The course of the disease in laboratory animals when injected with cultures grown in-vivo and in-vitro. CHARLES A. BEHRENS.

Acid production by colon-typhoid group. P. A. TETRAULT.

Soil bacterial types and green manuring. I. L. BALDWIN.

A simple method of determining the thermal death-point. JAMES B. KENDRICK and MAX W. GARDNER, Purdue Agricultural Experiment Station.

Botany

Further notes on the unusual stipules of acer nigrum michx. FLORA ANDERSON.

Unusual branching in cladophora. FLORA ANDERSON.

Plants new to Indiana. XI. C. C. DEAM.

Attack of fungi on the lids of water culture jars. F. M. ANDREWS.

The effect of pressure on seedlings. F. M. ANDREWS.

The convolvulaceae of Indiana. TRUMAN G. YUNCKER.

New Indiana weeds. ALBERT A. HANSEN.

Wild corn as a weed problem in Indiana. ALBERT A. HANSEN.

List of Indiana plants, chiefly from Putnam County, collected 1911-'15 by Earl Jerome Grimes. By title. MRS. EILEEN W. GRIMES.

Polyembryony in species of osmunda and dryopteris. DAVID M. MOTTIER.

Embryonic selection in certain species of nut-bearing pines. DAVID M. MOTTIER.

Phytophthora rot of tomato, eggplant and peppers. JAMES B. KENDRICK.

Clover mildew. E. B. MAINS, Purdue Agricultural Experiment Station.

Notes on microtechnique. M. S. MARKLE.

Chloroplasts of martynia fragrans. F. M. ANDREWS.

Quantitative aeration in leaves. F. M. ANDREWS.

Indiana plant diseases, 1922. MAX W. GARDNER, Purdue Agricultural Experiment Station.

Indiana fungi. VII. J. M. VAN HOOK.

Stem rust of wheat and the barberry in Indiana, 1922. Lantern. K. E. BEESON (introduced by H. S. Jackson), Purdue Agricultural Experiment Station.

An unusual iris. F. M. ANDREWS.

Second blooming of a snowball bush in the same year. F. M. ANDREWS.

The status of the hot-water treatment of wheat in Indiana. CHARLES GREGORY.

Some peculiar effects of formaldehyde treatment of onion for smut. CHARLES GREGORY.

Plants of White County. V. LOUIS F. HEIMLICH, Purdue University.

The microscopy of flour. By title. HAROLD E. TURLEY.

At the annual banquet the following officers for the year 1923 were elected:

C. A. BEHRENS, Lafayette, *President.*
F. PAYNE, Bloomington, *Vice-president.*
W. N. HESS, Greencastle, *Secretary.*
FLORA C. ANDERSON, Bloomington, *Assistant Secretary.*
W. M. BLANCHARD, Greencastle, *Treasurer.*
J. J. DAVIS, Lafayette, *Editor.*
H. F. DIETZ, Indianapolis, *Press Secretary.*

The meeting closed with a general program to which the public was invited.

GENERAL PROGRAM

The fundamental principles of radio transmission and reception. R. R. RAMSEY.

The scientific propagation of black bass in ponds as conducted at the Riverside Station in Indianapolis. Two reels motion pictures. G. M. MANNFIELD.

The artificial propagation of pike-perch. One reel motion pictures. G. M. MANNFIELD.

During the general business session an important change in the constitution of the academy was approved whereby the executive committee is now authorized to select the place at which the annual meeting of the following year is to be held instead of always holding this meeting in Indianapolis as the constitution previously required.

HARRY F. DIETZ,
Press Secretary.

SCIENCE

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MINING IN CANADA

CANADA covers the northern half of the North American continent, having an area of 3,729,665 square miles. About 700,000 square miles of this great area are covered with rich fertile soil, 900,000 square miles with forest, and 120,000 square miles with lake, etc., while over about 200,000 square miles the surface is buried under a thick blanket of moss. The remainder of the country, as well as some of the forested area, is rocky, and a study of how this rocky country should best be utilized for the benefit of mankind, is one of the greatest research problems of this age, a problem beside which most of those undertaken in our small laboratories dwarfs into insignificance.

The prospector and miner are the men who at the present time are doing most to work out the solution of this problem. In their work they have been assisted for the past eighty years by the Geological Survey of Canada, one of the earliest scientific research bureaus to be established on this Continent, and also, but in later years, by the Geological and Mining Bureaus of the various provinces.

In the 16th century when the gold and silver mines of South America and Mexico were attracting the attention of many of the leading men of the different nations of Europe, Canada did not entirely escape attention, for in 1576, three years after the rich gold mines of Minas Geraes of Brazil had been discovered, Martin Frobisher, one of the great sailors of the "Elizabethan Era," sailed from the Port of London in search of a northwest passage north of the Continent of America to Asia, where fabulous stores of metallic riches were believed to exist. He did not get half way to his destination, but was stopped by ice in a bay on the east side of Baffin Island, whence he returned to England. After his return a

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[1] Address of the president and vice-president of Section M, American Association for the Advancement of Science, December, 1922.

piece of black rock which he brought back with him, was drawn to the attention of the "gold finers" of London, who reported that it contained a considerable quantity of gold. In the following year, after receiving direct instructions and encouragement from Queen Elizabeth, he started back with three ships to look for more of this gold, having several "gold finers" with him. His ships were not of the class that we are accustomed to think of as crossing the Atlantic at the present day, for while one was of 180 tons, the other two were of about 30 tons each. After arriving at their destination, since known as Frobisher Bay, they labored hard for twenty days and loaded 200 tons of "ore," which they took back with them to England. Most of this "ore" was stored in Bristol Castle and the rest in the Tower of London. Samples were given out from time to time, but the returns on these samples seem to have been very contradictory. One assayer, who had been with Frobisher, and who had directed the "mining," claimed that if properly "treated and coaxed" it would yield £40 to the ton, while most of the goldsmiths of London said that they could not find any gold in it at all. Nevertheless many of the people interested in the expedition believed firmly in the richness of this reported gold discovery, the Queen being among the number. Accordingly it was decided to follow up the last expedition with a very much larger one, and for this purpose a fleet of fifteen ships was got in readiness. These took along not only the necessary crews to sail the ships and collect the ore, but a hundred men to form a settlement and remain at Frobisher's Bay for a year. The fleet sailed in May, 1578, and arrived at its destination about the 1st of August, though one ship sank on the way. Capt. Best of the "Ann Francis," one of the ships of the fleet, discovered "a great black island with plenty of black ore on it." The work of loading some of the ships went on through the month of August. While the "ore" was being mined and loaded, the masons and carpenters who had been brought from England to erect a fort, built a small stone house and within the house, they built an oven and placed some baked bread in it in order to show the Eskimos, who occupied the country, how to build a house and what to do in it when it was built. On the last day of August, all set sail for England, where they arrived about the 1st of October, but what became of the so-called ore is not known. Certainly the Company of Cathay, under whose name the enterprise was undertaken, met with financial disaster.

The scene of Frobisher's mining operations was unvisited for nearly three centuries, and it remained for Capt. C. F. Hall in 1861 and 62, while exploring in Frobisher's Bay, to rediscover all that was left of Frobisher's stone house and the pits dug by his men in their mining operations.

It might be an interesting trip for some of the many owners of yachts on the eastern coast of America to go to Frobisher's Bay and revisit the site of this mining stampede of three centuries and a half ago. It is possible that the black rocks referred to by these old sailors may have belonged to the Keewatin or Pre-Cambrian series which is yielding such large quantities of gold in Porcupine at the present time.

The next record that we have which would indicate any interest in the mineral wealth of Canada was in 1609 when Master Simon, a French mining engineer who accompanied a military expedition under De Mont, discovered native copper at Cape Doré on the east coast of Nova Scotia.

In 1672 Denys mentions coal seams near Sydney, Cape Breton, this being the first record of coal on the Continent of America. From that time onwards coal has been mined more or less continuously from these seams. In 1711, a British naval expedition sent to attack Quebec obtained coal from these seams where they outcrop in the cliffs, and later in 1720, systematic coal mining was begun by the French to supply the men building the fortress at Louisburg, and those living in the colony at Halifax, the amount usually raised for this purpose being from two to three thousand tons a year. The coal mining industry in Nova Scotia has gone on apace since then, the annual production at the beginning of this century being 3,300,000 tons, and for 1920 it was 6,429,200 tons.

Going farther west into the Province of Quebec, the early settlers recognized the existence of bog iron ore about the middle of the 17th century.

In 1686, Chevalier De Troyes, accompanied by D'Iberville and his two brothers, the heroes of many battles with the British, started in March from Montreal through snow-covered woods and over ice-bound rivers, with a party of one hundred armed men to attack, and if possible to destroy, the fur trading posts belonging to the Hudson's Bay Company on the shore of Hudson Bay. They traveled westward up the Ottawa River and then northward across Lake Timiskaming. While on this lake, they visited a lead mine, on its east shore, just opposite and only twelve miles away from the rich silver mines at Cobalt. Dr. Miller, of the Ontario Bureau of Mines, in one of his papers on the Cobalt District, has asked the question, "What would have happened if these Frenchmen had discovered the rich native silver ores of Cobalt, which would have competed in richness with the greatest of the silver ores of Mexico or Peru?" The question was of course unanswered.

In the beginning of the 18th Century the few white men who were in charge of the fur trading establishments of the Hudson's Bay Company, on the shore of Hudson Bay, became excited over stories brought in by Indians of great quantities of native copper which could be picked off the ground on the banks of a river away to the north, and in 1719 Captains Knight and Barlow sailed in two ships, well provided with provisions, and also with strong iron-bound boxes in which to bring back precious metals, for the north west point of Hudson Bay. They were wrecked on Marble Island and all were lost.

Three years later Captain Scroggs took another expedition up the west shore of Hudson's Bay, and Richard Norton, who was in charge of the trading post at Churchill, continued the search by land for many years.

In 1769, fifty years after Knight's ill-fated expedition, Samuel Hearne was sent inland from Churchill on foot with a band of Indians to find the great deposit of copper on the bank of the distant river. He reached the Coppermine River near its discharge into the Arctic Ocean, and verified the existence of native copper in its vicinity, but at the same time he showed that the quantity obtainable was too small to be of commercial importance.

In 1737 iron furnaces were built at St. Maurice in the Province of Quebec to smelt the bog iron ore of the vicinity. They supplied the people of Quebec with their iron for many years, and in fact have been in blast almost down to the present time.

In the Province of Ontario, the first iron furnace was built in 1810, in the County of Leeds, and the next one in 1813 at Normandale in Norfolk County near the shore of Lake Erie. This furnace remained in blast down to 1847, using bog iron ore and charcoal and producing about three tons of iron a day. The iron was used in the foundries throughout that portion of Canada for the manufacture of stoves and all ordinary iron articles.

Gold was first discovered in the gravels of the Chaudiere River and its tributaries in the Province of Quebec about 1823 or 1824, and from that time onwards some gold was recovered every year, the most active operations having been undertaken between 1860 and 1875. Altogether about $3,000,000 worth of gold has been extracted to date by mining operation from these gravels.

In 1859 or 1860 some of the pilgrims crossing the plains from the Red River Country, either from what is now the Province of Manitoba, or from the State of Minnesota, discovered gold in the sands of the Saskatchewan River, and from then until now, the sands of that river have reguarly yielded a little gold to the placer miners. In some years the yield was as much as $50,000 and in other years very much less. Altogether the river is believed to have yielded more than $600,000 worth of gold.

In British Columbia gold was discovered in 1852 in gravel at Gold Harbor on the west coast of Queen Charlotte Island, though very little mining was done. In 1857, it was discovered on the Fraser River, and in the following year a great stampede set in from California, and the country to the south, to these new diggings. Prospectors pushed up Fraser River from bar to bar, and then back through the country until, in the winter of 1860-61, they crossed over to Williams Creek and discovered the rich placers of Cariboo.

About this time the precious metal was discovered in quartz veins in Nova Scotia. These veins which occur in folded Pre-Cambrian rocks have been producing gold from that time up to the present, the total yield to date being about $18,000,000.

Six years later gold was discovered in Hastings County in the Province of Ontario. The men who made the discovery knew so little about the metal that they would not believe that it was gold until they had the word of a member of the Geological Survey of Canada.

In 1868 silver was discovered by the Montreal Mining Co. at Silver Islet, on a little rocky island, less than an acre in extent, near the north shore of Lake Superior. During the next few years this mine yielded more than $3,000,000. In the vicinity of Silver Islet on the shore of the lake, silver had already been known to exist, and some small mines in that vicinity have yielded a little ore, but none of them have been sufficiently productive to add materially to the wealth of the country. After the ore at Silver Islet was exhausted, silver mining remained quiescent in Eastern Canada until the rich deposits at Cobalt were discovered in 1903.

Copper had been known to exist on the shores of Lake Superior for a century or more, but the valuable ore bodies all seem to be collected on the American side of the lake rather than in Canada. In 1847, copper ore was found at Bruce Mines on the north shore of Lake Huron, and mining was carried on there for many years with varying success.

In the decade following 1858, copper mining was prosecuted energetically and often successfully in the eastern townships of the Province of Quebec, and at one of the mines a shaft was sunk to a depth of 3,000 feet.

In 1847, the occurrence of asbestos was made known by the geologists of the Geological Survey of Canada in the southern portion of Quebec and thirty years later active mining and milling of the ore began. This industry has now developed into the largest mining industry in Quebec and provides most of the asbestos used in the world.

Such was the condition of mining in Canada in the year 1885, when the Canadian Pacific Railway was opened throughout its length from the Atlantic to the Pacific. At that time the country had a population of five million three hundred thousand people, almost entirely engaged in agricultural pursuits or in developing the immediate products of agriculture. The early settlers, both French and British, were agriculturists and had settled on the rich farming land near navigable waters, whether of the Atlantic Ocean or of the Great Lakes, for the waterways formed the main lines of transportation through the country. There were vast areas of similar rich land in the wilderness back from the water, but it could not be easily reached and little was known about it. Highways and railways were afterwards built through or near the parts of the country that had thus been settled, but the people did not begin to move into the great interior regions of Canada until about 1885, when the northern parts of the Province of Ontario, and the Provinces of Manitoba, Saskatchewan, Alberta and British Columbia were rendered accessible by the building of the C. P. R. from Montreal to Vancouver. Up to that time in spite of the many discoveries of minerals and ores of various kinds which had been made at widely scattered localities throughout the Dominion, the actual production was still very small. In 1886, the first year in which an accurate statistical report on mineral production was compiled and issued, the total output of useful minerals of all kinds, metallic and non-metallic, had a value of only $10,220,000 or $2.23 to the head of population.

A new mining era had however begun to dawn for us. The building of the C. P. R. provided means of access to a previously inaccessible country. New districts were opened up. In a rock cutting on the right-of-way of this new railway itself was exposed for the first time one of the deposits of nickel ore near Sudbury, Ontario, where the greatest nickel mines of the world are now situated.

About that time systematic geological exploration of the Rocky Mountains was begun by Dr. G. M. Dawson, one of the geologists on the Geological Survey of Canada, and with him I had the pleasure of being associated as assistant. We explored from the International Boundary northward to the Bow river, and during the summer of 1883 we determined the existence of the great coal seams in the Crow's

Nest Pass. I remember very well, a hot day on the 12th of July, when camped on the banks of Mitchell creek, on land which I believe is now owned by the Crow's Nest Pass Coal Company, we divided our energies, he going up stream and I down, and my gratification at finding the outcrop of a beautiful seam of coal three feet in thickness.

Farther west in British Columbia the great silver-lead mines of East and West Kootenay and Slocan districts were discovered and active development was begun on many of them.

As a consequence of this increased interest in mining, the mineral production rose in four years to $16,763,000 or $3.50 to each head of population.

During the next five years discoveries and development were continued with unabated enthusiasm, and production increased steadily, so that by 1895 the value of our mineral products had reached $20,500,000, or $4.05 per head, having doubled in less than a decade.

The following year the rich gold placers of the Klondike were discovered, and by 1900 the output of all our mines had increased to a value of $64,400,000 or $12 per head of population. In five years the value of the mineral production had more than trebled. Half of this increase, or a third of the total production, was derived from the rich placer mines of the Klondike, where the value of the output for 1900 was $22,275,000, but the other half of the increase was due to the general interest which the people were taking in mines and to a consequent general increase in the mineral output of the whole country. For instance the output of the mines of Nova Scotia increased $4,500,000, due chiefly to the increase in output of coal, and of British Columbia $10,700,000 made up of gold, silver, copper, lead and coal.

After 1900 the production of gold from the placers of the Klondike quickly declined, and by 1905 it had dropped from $22,275,000 to $7,875,000, but notwithstanding the heavy decrease in the production of that very interesting old camp just south of the Arctic Circle, where I myself spent seven years of my life, mining had been so successfully prosecuted throughout the Dominion that the general mineral production, instead of declining, had increased to a value of $69,000,000. This increase was divided among the various provinces as follows:

Nova Scotia, $2,200,000, chiefly coal; Quebec, $1,100,000; Ontario, $7,600,000; Manitoba, Saskatchewan, and Alberta, $3,500,000; and British Columbia, $5,700,000.

Towards the close of this half decade a new silver field was found among the pine forests of Northern Ontario by some of the men who were working on the construction of the new T. & N. O. Ry. The influence of the find was just beginning to be felt and in 1905 it accounted for about $1,400,000 of Ontario's increase. The center of this silver district is now the town of Cobalt, and up to the end of December, 1921, it had produced 323,324,000 ounces of silver, valued at $198,170,000, and its mining companies had paid $92,283,820 in dividends to their stockholders. Considering the great richness of its veins, the ore in a number of places running as high as 10,000 ozs. to the ton, and its small area, the district is one of the richest of the great silver-bearing areas of the world.

In 1910, our mineral production had increased from a value of $69,000,000 in 1905 to $106,800,000. $14,000,000 of this increase was due to the output of silver from Cobalt, while $23,000,000 was due to the general increase in mining throughout the whole of Canada. In the provinces other than Ontario, the increases were as follows: Nova Scotia, $2,700,000; Quebec, $3,800,000; Alberta, chiefly coal, $7,000,000; British Columbia, $2,100,000. At the end of this period the Porcupine gold district in Northern Ontario had been discovered, but production had scarcely begun.

In 1915 our mineral production had increased to a value of $137,000,000, with a per capita value of $17.30, the greatest increase being in the Province of Ontario, which had raised its output from $43,000,000 to $61,000,000, the items chiefly responsible for this increase being gold and nickel. Nova Scotia, Quebec and British Columbia also showed substantial increases in spite of the fact that some of the metals, etc., had had a substantial drop in value during the first years of the Great War. The value of the total metallic production in this year was $75,800,000, the principal items of which were nickel, gold, copper and silver in the order here given, while the non-metallics had a value of $61,200,000, of which coal accounted for two thirds.

In the five year period ending in 1920, the value of our mineral production almost doubled, being in this latter year about $228,000,000, but in this instance the increase was largely in the non-metallic products, coal alone having increased in the value of output from $32,000,000 to $80,000,000. In Nova Scotia the increase was from $18,000,000 to $34,000,000 due to coal, in Quebec from $11,600,000 to $28,800,000, chiefly due to asbestos, in Ontario from $61,000,000 to $81,800,000, Alberta $9,900,000 to $33,600,000 due to coal, British Columbia, $28,700,000 to $39,400,000, its chief products being coal, copper, silver, zinc, lead and gold in the order named. Taking the whole Dominion the chief mineral products were now in order of value, coal, nickel, gold, asbestos, copper and silver.

A feature of this half decade was the great development of coal mining in Alberta, which in 1920 led all the other provinces of the Dominion.

However, the most spectacular characteristic of the decade from 1910 to 1920 was the development of the great gold mines of Porcupine and Kirkland Lake in Northern Ontario. The first gold production was in 1910, amounting to 3,089 ozs. of a value of $62,849. In 1915 it had risen to 406,577 ozs. with a value of $8,404,693. For the next three years both development and production were greatly retarded on account of the scarcity of labor, for most of the friendly miners had joined the army and were fighting for the Allies, while the mechanics that were not in the army were in munition factories. By 1920, however, labor had become more plentiful and more efficient, and production was again on the increase. In that year Porcupine and Kirkland Lake produced gold to the value of $11,686,043. In 1921 this had increased to $14,624,085, and during the year just past it will doubtless reach $21,000,000, which will place it far in advance of California, or any of the other States of the Union. For the whole of Canada the gold production for the past year will probably reach a total of $27,000,000, which will place it easily third among the gold producing countries of the world, being only exceeded by Africa and the United States.

The development of the mineral resources of the country has depended on transportation. We have seen that it had scarcely begun until the C. P. R. was built across the continent. This gigantic railway enterprise cost $680,000,000, and now our mineral production alone is rapidly reimbursing us for the great expenditure, and of course the increase in the agricultural production of the country is many times that of its mineral production.

Thus you see that although there have been spectacular discoveries of great mineral wealth in Canada at various times, and in various places, such as in Cariboo, Klondike and Cobalt, and although these fields have all declined in production, nevertheless other discoveries, perhaps not so spectacular, were made, and new mining fields were opened so that every fifth year there has been an increase of production over the previous fifth year, and that in 34 years the production has increased more rapidly than in any other country in the world, except possibly South Africa. Canadians are naturally proud of this record, even though the credit may rest much more largely with the country than with themselves.

I have presented these figures as evidence of Canada's steady and uninterrupted growth in mineral, production, but nevertheless it must be remembered that her population is yet very small, less than three to the square mile, and almost all of these are distributed near its southern border. Most of the knowledge of the mineral and other resources of the country has been acquired by the people who live in this southern border belt, and the greater part of such knowledge refers to the country immediately contiguous to, or at least at no great distance from, this belt.

Thus though Canada has developed into an important mining country, its mines are all situated in, or not far beyond the confines of, this southern border belt, and the vast country beyond is yielding practically nothing. Among the producing mines are the great nickel-copper mines of Sudbury, the chief source of the nickel supply of the world; the silver mines of Cobalt, perhaps the richest silver-bearing area of the world; the gold mines of Porcupine, which comprise three of the greatest gold mines of the world, together with important mica, feldspar, and talc mines, all in the Province of Ontario; the asbestos mines of Quebec, the source of most of the asbestos of the world; the coal mines of Nova Scotia and Alberta, and the coal, copper, lead and gold mines of British Columbia. There are doubtless many mines yet to be discovered in the southern border belt, in the vicinity of those already known and in active operation, but farther north is a vast area which is still unoccupied and the mineral resources of which are yet undiscovered. The means of transportation into it are slow and imperfect, and no dependable local supplies of food are available, so that even when men penetrate into it, as they can do in canoes, they are unable to live and work there until they can obtain a regular supply of provisions from the settled country to the south. But, as you know, transportation facilities are being improved all the time. With these improvements the frontiersmen who are accustomed to live on the borders of civilization, and to start the development of a country, continue to push farther into the wilderness. They make the first discoveries where the exposures of minerals are most conspicuous, but after having made these they push farther into the wilderness and leave development to those who come forward from the larger centers of population. The three processes of discovery, development and production keep going on at the same time in different parts of the country, and as long as we have new country to explore we may be reasonably certain that new discoveries will be made and that production will increase.

The mere fact that a country has been travelled over for years by fur traders and foresters, and that mineral wealth has not yet been discovered in it is little or no indication that such wealth is not present in its rocks. Cobalt was in the middle of one of the finest white pine areas of Northern Canada, and the lumbermen had been working in it for a long time before the contractors and laborers on the T. & N. O. Ry. discovered silver in it; and the Hollinger Mine, one of the great gold mines in the Porcupine district in Northern Ontario, was right on a portage which had been used by fur traders for a century or more, and when the gold-bearing quartz veins which are now yielding gold so abundantly were discovered by the prospectors, they had already been polished by the moccasins of the traders and packers as they carried their furs down to Moose Factory on Hudson Bay, thence to be shipped to London.

At the present time our country offers a field for extensive and intensive research second to none in the world. One of the main objects of that research should be the finding of bodies of ore which could be economically developed and utilized for the benefit of mankind. There is no finer laboratory anywhere than the one in which this research must be conducted, for it was constructed by the Great Architect of the Universe himself, it is almost limitless in size, in variety of problems to be solved, and in the facilities for solving them.

Up to the present time most of the known mineral deposits of the country have been accidentally discovered by hunters, casual wanderers through the wilderness, or prospectors who have had very little training except in the school of hard knocks, although it must not be forgotten that our Scientific Departments, such as the Geological Survey of Canada, and the Geological and Mining Bureaus of the various provinces, have often pointed the way to the areas where rocks and structural conditions are the most favorable for the occurrence of ore, and where, consequently, exploration might be undertaken with the greatest likelihood of success. I hesitate even to hazard a guess as to how far our mining industry would be behind its present stage of development, were it not for the assistance given it by these departments.

But if most of the prospectors and discoverers have not been trained in colleges and universities, most of the men who have taken charge of the development of the mines after they were discovered have been college men, and the success achieved by them has doubtless been in no small measure due to their college training. The need of scientific training for mining engineers, and for all those in any way connected with the production of our mineral wealth, is increasing every day, for their work is becoming vastly more complex and difficult.

Some college trained engineers who desire or need a life in the great outdoors will use their training and knowledge in the discovery of ore bodies, where untrained men would not be likely to find them, or would pass them by. Other trained engineers will explore these ore bodies and if found to be sufficiently rich or large, will pass them on again to others, who will develop them into producing and paying mines.

Your universities as well as ours can assist in the development of Canada by giving a thorough training in mining and geology, with all the collaterals that these sciences imply, to all three classes of engineers mentioned above, and also to directors or prospective directors of mining companies so that they also may understand and appreciate the work done by their several engineers. With such assistance the Canadian Mining industry would increase and develop at an even more rapid rate than it has done in the past.

J. B. TYRRELL

THE SCIENTIFIC RESOURCES OF FRANCE

To those who harbor an impulse which keeps them, throughout life, arduously laboring in scientific fields, the great cultural institutions of France appeal with peculiar power. Some of my French friends remark, "Yes, the Frenchman invents, creates and embellishes and then ceases to interest himself in the creatures of his mind." A surgeon whose name is internationally honored said, when the purpose of this paper was explained and his aid sought in the collection of material, "C'est très important! En France, nous créons des grandes organisations, et après, nous nous en moquons trop!" In a sense it may be true that the intellectual wines of Europe need no bush, yet descriptions of the educational resources of the Old World never fail to be eagerly scanned by the American scientific public and what may be termed our general student body. Novel light on the ancient beaten paths which all students must tread, pointing again the rough, unroyal highway in which the world's best workers have bruised their hearts and cudgelled their brains, seems ever welcome. It reminds present pilgrims of the beautiful democracy of ideas, or aristocracy of ideas, if you will, which has placed marvelous forces within reach of every human mind which would seek to employ and direct them. And, besides an undertaking for my own countrymen, the present paper constitutes a labor of love and humble tribute devoted to the genius of France. Probably there have never been as many American students in attendance at French institutions as now. There is every indication that their number will be continually swelled. The old wells of knowledge still flow and the strata of fact ever accumulate in the world's huge centers. The flood of inquiring spirits surges about the doors of hoary institutions and threatens to submerge and block their portals, yet is somehow sluiced away, leaving ample room for perpetually rising tides.

The undergraduate institutions, such as the Sorbonne, University of Paris, and provincial universities like those of Lille, Lyon, Strasbourg, Bordeaux, Montpellier, Grenoble and many others possess libraries, laboratories and museums which may be utilized by postgraduate students. In fact, the special student may find that his particular needs will require a visit to one or more of the schools outside Paris. For French students living far from Paris the local university and its attributes are highly important. The foreign student naturally first interests himself in Paris.

At Paris, the Institut de France, Académie de Médecine, Collège de France, Institut National Agronomique, Académie d'Agriculture, Institut Pasteur and, especially, the libraries, are supremely interesting. In addition, the Observatories, Radium Institute, various museums, the Polytechnic School, Institute of the Arts et Métiers and other special colleges, laboratories and manifold sources of information are available to the special worker.

All these organizations are separate and independent. Sometimes a loosely common tie is constituted by direction by the same ministry, such as that of the Public Instruction, Agriculture, etc. However, the faculties, officers and members are not officially inter-related. The institutions have originated differently and developed, each by itself, through centuries of changing and often troublous history. In a paper of this kind, scarcely more than mere mention can be made of the very numerous educational resources centering in Paris alone. However, something of a sketch will be attempted. And, in this endeavor, the institut has been selected, first, because it constitutes the summit of French intellectual achievement and second, because it is a type generally representing the learned bodies of France. It is here concerned mainly on account of a single one of its five constituent Academies, the Académie des Sciences. In justice to the institut, this state monument of surpassing interest to all liberal minds, a review is indispensable. The principal chronology may be tabulated in the following scheme:

1635. Richelieu interests himself in an existing literary society, whose meetings are held with one of the members, Conrart. Becoming the protector of this society, Richelieu lays the foundation for the future Académie Française.

1648-71. Royal Academy of painting and sculpture, and Royal Academy of architecture, aided by Mazarin and Colbert.

1663. Royal Academy of Inscriptions et Belles Lettres organized by Colbert.

1666. First meeting, December 22, of the Royal Académie des Sciences.

1793. Suppression of all intellectual organizations by the revolutionary National Convention.

1795. True birthday and foundation of the Institut, October 25 (Brumaire 3, Year IV), under the title "Institut National des Sciences et des Arts." The new Institut was not related to the preexisting Academies, except in so far as the fact that some of their members became members of the Institut. The Institut was composed of three classes, namely, of the physical and mathematical sciences, moral and political sciences, and French literature and fine arts.

1803. Reorganization by Napoleon's Con ular Decree of January 23 (Pluviôse 3, Year XI), with abrogation of the class of moral and political sciences and formation of the four classes of the physical and mathematical sciences, French literature and language, ancient history and literature, and fine arts.

1816. Interesting principally because the term "Académies" was substituted for that of "Classes."

1832. Royal decree restoring the class (called Académie) of moral and political sciences.

This skeletonic calendar suggests the present composition of the Institut. The latter is autonomous, consists of five Academies and is maintained by funds provided by the French government and bestowed by private individuals. In the order of their usual ranking, the constituent Academies are the Académie Française, Académie des Inscriptions et Belles Lettres, Académie des Sciences, Académie des Beaux Arts and Académie des Sciences Morales et Politiques. The president of one of the academies automatically rotates to the presidency of the Institut. Each academy is represented in the presidency of the Institut for a year. The chief of the Académie Française, the only officer styled "Director," is elected every three months, presidents of the four other academies being elected annually. Accordingly, in years when the presidency of the Institut is represented by the Académie Française, the Institut has four presidents, each serving for three months. This condition chances to exist in 1922, the present president of the Institut being Monsieur Henri Regnier, director of the Académie Française. The secretary is Monsieur Frédéric Masson.

The secretaries of the academies are perpetual and elected for life. They constitute the real directors, since they thus remain in contact with permanent policies. In association with two members delegated to the central administrative committee described further on, they administer the academies' finances. They also designate the programs of the weekly meetings and supervise publications. Perpetual secretaries are practically always great savants. Among those who have so served are Joseph Bertrand, Darboux, Cuvier, Arago and Pasteur. After becoming ill and unable to continue active secretarial duty, Pasteur was made perpetual honorary secretary in the Académie des Sciences.

As shown by the chronological table, the Institut dates from 1795. Before this date, the various academies, which had been created and developed under Louis XIII and Louis XIV, were entirely separate and independent. Liberal thought had begun to flourish actively by the time when its exaggerations, combined with France's difficulties, had precipitated the Revolution. The dominant spirit in the National Convention feared free thought and opposed it. Saron, Bailly and Lavoisier were guillotined, while Condorcet preferred suicide. These men were destroyed because of their political activities and, so to speak, in spite of, and not by reason of, their scientific accomplishments. The royal decree of 1832 fully restored all the elements suppressed by Napoleon and launched the Institut on a course which has been practically uninterrupted since that time.

The governmental funds allotted to the Institut are apportioned as follows:

Académie Française	150,000 francs
des Inscriptions et Belles Lettres	79,000
des Sciences	175,600
des Beaux Arts	97,400
des Sciences Morales et Politiques	87,400
Library	15,600
General	81,400
Total	688,400

Obviously, the library fund is utterly insufficient. At the present rate of exchange, it is equivalent to about $1,500, or to about $3,000 only, were exchange at the prewar rate. The library is cyclopedic, containing valuable works on all the subjects in which the several academies are interested. On account of the paucity of this library fund, and especially in view of the fact that the government will be unable to supplement it for a long time because of the grave post-war financial conditions, the Library of the Institut would be most grateful could it receive, free, the important bulletins and other valuable publications issued by the United States government and by the several states. An appeal of this kind is hereby made to the federal bureaus and to the numerous educational, scientific and other liberal agencies existing in all our states. National, state, university and other publications may be sent to the Conservateur de la Bibliothèque de l'Institut, 23 Quai de Conti, Paris. Perhaps in no way can our country so effectively aid the country which so materially secured to us our victory in the days when our independence was darkly and gravely uncertain. With us, it must be remembered that the question of this sort of assistance is scarcely one of material cost, for free publications by the bushel, of which one copy each would be gratefully cherished by the Institut library, are unceremoniously dumped into American wastebaskets.

The Institut administers various foundations and awards many prizes. Of the government funds, only 22,000 francs are devoted to prizes. The funds of the several academies, and the general and library funds of the Institut, are administered by a committee, the Commission Administrative Centrale, composed of the perpetual secretaries and two members delegated by each academy. Excepting secretaries, each member of the Institut receives 1,200 francs annually. Secretaries receive 8,000 francs.

It must be remembered that the foundations bestowed upon the Institut must be administered according to the specifications of the donors. These specifications are usually precise, thus largely leaving the Institut powerless to convert the funds otherwise, even in the presence of great emergency, such as that confronting the library. Of these foundations, perhaps the most generally useful is the Jean Debrousse Foundation of 1900, consisting of a million francs. From this foundation, various sums are expended in the aid of scientific, historical and other works, and for the maintenance of publications. The Montyon prizes are very important. The most important single prize, the Osiris, of 100,000 francs, is awarded triennially for outstanding contributions to science, letters, art, industry or general public welfare. Roux, who was director of the Pasteur Institute when awarded this prize in 1903, immediately bestowed it upon the Institut Pasteur.

Various museums, chateaux, estates, etc., have been bestowed upon the Institut and constitute important research resources, largely in the fields of [illegible] orga[illegible] and literature. Among these are the [illegible] Soum of Chantilly (Museum Condé), given by the Duc d'Aumale; the estate at Chaalis and the Museum Jacquemart-André, in the boulevard Haussmann, at Paris, bestowed by Madame Jacquemart-André; the Chateau de Langeais and Hotel de Thiers, at Paris; and the Abbadia Observatory of the Académie des Sciences, situated at Hendaye, on the Spanish frontier near Biarritz.

The library of the Institut, partially discussed above, is private, situated on the premises of the Institut at 23 Quai de Conti, and open on Mondays, Thursdays, Fridays and Saturdays, from noon to 6 P.M. Workers must be introduced by members of the Institut. The Mazarin library (Bibliothèque Mazarine) is also quartered on the site of the Institut. It is public, and chiefly devoted to history and literature. It is quite independent of the Institut library.

The creator of the Académie des Sciences was Colbert, controller of finance under Louis XIV. Among its members have been Lavoisier, Condorcet, Buffon, Lagrange, Laplace, Biot, Ampère, Fresnel, Lamarck, Becquerel, Dupuytren and Magendie. Some of the distinguished perpetual secretaries have been already named. Bonaparte was elected a member in 1797.

The membership comprises a total of 218, of whom two are the perpetual secretaries. The classes of members are titular, or regular (68), free (10), non-resident (6), corresponding (116), foreign associate (12) and include 6 members from the new section on the Application of Science to Industry. Free members are not necessarily great savants, but may be chosen on account of their scientific interests and general relations. They receive no compensation and have no vote in elections. Corresponding members may vary in number and represent various regions of France, the French colonies and foreign countries. Foreign associates are always scientists of the first order.

The members are distributed among 12 working sections, namely, of Geometry, Mechanics, Astronomy, Geography and Navigation, General Physics, Chemistry, Mineralogy, Botany, Rural Economy, Anatomy and Zoology, Medicine and Surgery, and Application of Science to Industry. Meetings, free to the public, are held Monday afternoons. Ladies must have a card of admission, which is readily obtainable. The proceedings, including papers, demonstrations, etc., are reported in the *Comptes rendus hebdomadaires de l'Académie des Sciences*. The academy also publishes *Mémoires des Savants Etrangers* and mémoires, or articles, written by the members. In 1878, Edison's phonograph, then not fully completed, was presented at one of the meetings. In order to prove good faith, the demonstrator was obliged to submit to having his nose held, to eliminate ventriloquism. Gouraud and Janssen gave the final demonstration on April 22, 1889. An annual meeting, open to the public, is held in December.

Fifty foundations are administered by the Académie des Sciences. Six Montyon prizes provide a total of 44,845 francs for award. The Guzman prize offers 100,000 francs for proved communication with any heavenly body excepting Mars. Scientific thought is still further stimulated by the Caze prizes, each of 10,000 francs, in physiology and physics; the Caze and Jecher prizes of 10,000 francs each, in general and organic chemistry; the Plumey prize of 4,000 francs, in steam navigation; and by a number of prizes in botany, geography, mathematics, exploration, mineralogy and various other subjects. Moreover, the prizes, medals and other honors bestowed by the Institut are not all limited to the French. Many are freely at the disposal of every race and people, within the limits of merit only.

The conditions of award, prize-lists and other information may be obtained by addressing the Secrétaire Perpetuel de l'Académie des Sciences, Secrétariat de l'Institut, 23 Quai de Conti, Paris. Competing manuscripts should be received at this address by December 31 of the year preceding that in which the competition will be judged. Prizes are awarded at periods varying from one to five years. Scientific works competing for award must be written in French and three copies, with a letter, must be filed with the Secrétariat.

The present president of the Académie des Sciences is Monsieur Emile Bertin. The two perpetual secretaries are Messieurs Emile Picard and Alfred Lacroix. Some of the members are Painlevé, Appell, Roux, Deslendres, d'Arsonval, Admiral Fournier, Haller, Richet, Quénu, Widal and Moureu. Marshal Foch and Prince Roland Bonaparte are free members. The late Prince of Monaco was a foreign associate. Other members not American include Sir Edwin Ray Lankester, Pavlov, Cajal, Yersin, Depage, Wright, Bordet and Bruce. How can one select luminaries from such a firmament?

Members of the Académie Française must be

French. Not so with the other academies. A total American membership of about twenty is distributed among the four other academies of the Institut. American foreign associates of the Académie des Sciences are Dickson, Brown, Campbell, Davis, Loeb, Hale, Waddell, Michelson and Walcott.

The Académie de Médecine, 16 rue Bonaparte, succeeded, by a royal decree dated December 20, 1820, the ancient Académie Royale de Chirurgie and the Société Royale de Médecine. Like most other institutions, it is independent. Its eleven sections are those of anatomy and physiology, medical pathology, surgical pathology, therapeutics and natural medical history, operative medicine, pathological anatomy, obstetrics, public hygiene, legal medicine and medical policing (the last three in one section), veterinary medicine, medical physics and chemistry, and pharmacy.

The members are titular (100), free associates (10), national associates (20), foreign associates (20), national correspondents (100) and foreign correspondents (50). The proceedings are published in the weekly *Bulletin de l'Académie de Médecine*. The private library is freely at the disposal of physicians and surgeons, pharmacists and others interested in medical subjects. Recommendations made to the government by committees of the academy are always seriously considered, and frequently adopted, by the public powers. Many of the great sanitary and hygienic reforms of France are due to the labors of responsible committees appointed by the academy. The membership embraces many of the well-known French medical and surgical authorities. Madame Curie, recently elected, is the first and only woman member.

Naturally of kindred interest with the Académie de Médecine is the Institut Pasteur, 25 rue Dutot. The Institut Pasteur is composed of three sections, on microbiology, serotherapy and biological chemistry. The rabies service falls in the first section. The animals required for the serum service are kept at Garches. The laboratories are those of physiology, fermentation, agricultural chemistry, therapeutic chemistry, physical chemistry, biological chemistry and serotherapy. The Institut also possesses laboratories of exotic pathology, protozoology and entomology, situated at 96 rue Falguière. The present director is Dr. Calmette. Among the laboratory chiefs are Bertrand, Levaditi, Mouton, Fernbach, Marie, Besredka and Nicolle.

Foreign students are welcomed. Free theoretical courses in bacteriology are given. For a small, selected class of postgraduate students, practical courses are given in naval and military medicine, public health, and preparation of vaccines, serums, culture media, etc. The free rabies service discharges a service dignified far beyond the measure of human praise. A beautiful isolation hospital, attached to the Institut, lies just across the street. The Institut library, now emerging from its chaotic war period, may be readily consulted by qualified students. Every visitor should see the crypt and tomb of Pasteur. Affiliated Instituts Pasteur are situated at Lille, Algiers, Tangier, Tunis, Brazzaville (Congo region) and at Nha-Trang and Saigon in Indo-China.

The Collège de France was founded by François I. No fees are asked, except for laboratory work, and no diplomas given. About forty professors compose a faculty lecturing on languages, history, literature, etc., and in some twenty-five branches of science. Arrangements to attend lectures or work in the laboratories should be made in September or October with the appropriate lecturers. The address of the Collège de France is Place Marcellin-Berthelot, Paris. Special laboratories are situated at the Parc des Princes, Avenue Victor Hugo, Boulogne-sur-Seine and at Meudon. The Institut d'Hydrologie et de Climatologie, a part of the Collège, possesses laboratories of physics, chemistry, hygiene and hydrology. A group of museums is situated at the Jardin des Plantes, founded in 1636. Many courses are given at the Jardin, among which are those on annelids, mollusks, zoophytes and zoology (birds and mammals). A School of Botany is also conducted at the Jardin and a course in paleontology given at the Museum of Paleontology.

The Institut National Agronomique, 16 rue Claude Bernard, is directed by the Ministry of Agriculture. It possesses various laboratories. It has an experimental farm at Noisy-le-Roy. The Académie d'Agriculture, 18 rue de Bellechasse, is devoted primarily to the preparation of information utilized in guiding agricultural legislation. Like the Institut Agronomique, it is attached to the Ministry of Agriculture, but has no connection with the Institut Agronomique. It includes nine sections, has seventy-two titular members and various correspondents and associates, offers a number of prizes and publishes the *Comptes rendus des Séances de l'Académie d'Agriculture.* Among noted members have been Buffon, Calonne, the King of Siam, Edward VII and George V of England, Jussieu, Malesherbes, Pasteur, Roux, Turgot and Vicq-d'Azyr. David B. Warden represented America in 1834, L. O. Howard is now a foreign member and George Washington was a foreign associate from 1789 to 1793. In 1793, the Académie d'Agriculture shared the common fate of dissolution by the Convention.

The limits of this paper are approaching. No discussion can be given at present of the observatories, Sorbonne, hospital clinics, the marine laboratories of Cette, Roscoff, Banyuls, etc., the Radium Institute, Oceanographic Institute and Museum, Bureau of Longitudes and many another cultural organization.

Libraries are attached to all the institutions discussed. Many of the Paris libraries are devoted largely to history, art and literature. The Bibliothèque Nationale, at 58 rue de Richelieu, is the most important public library in France. It grants opportunities for research on permission obtained in writing from the Secretariat. This library is of especial interest to all students, since it is the official depositary for all scientific and other works published. Next in importance among general libraries ranks the library of St. Geneviève, close to the Panthéon [illegible] and [illegible] products 10 P.M. The librar[illegible]cess and gasoline and divi- cine, at 12 rue de l'E[illegible] what Bacon called exper[illegible] and useful, and conta[illegible]d it must ever be kept [illegible]

The "Ressources du [illegible]ally urging) that expe[illegible] France" (see bibliogra[illegible] more to be sou[illegible]n- valuable summary of French [illegible]ti- tutions, including libraries. Card cat[illegible] as we know them are not generally used in European libraries, partly because valuable works and historical documents, composing much of the material, can not well be placed freely at the disposal of the merely casual reader. It is usually very easy to obtain any books, manuscripts, etc., desired.

Were I the arbiter *elegantiarum scientiæ,* I should suggest undergraduate study for the first two years in Europe, the last two in America, one or two postgraduate years in America, then for a year or two back to Europe, and so on alternately as long as the consequent intellectual labor might be practicable. By this outline I do not mean mere passive travel in ways blazed by others, but the supplementing of one's own fruitful accomplishments with study of the gifts in similar fields bestowed upon humanity by one's peers and fellows.

In closing, I wish to express especial acknowledgment of kindnesses for which I am indebted to Dr. Tuffier, and particularly to M. Henri Dehérain, curator of the Library of the Institut de France, who reviewed the manuscript and made many invaluable suggestions.

THEODORE C. MERRILL

PARIS, 10 BIS RUE HERRAN,
AUGUST, 1922

BIBLIOGRAPHY

Annuaire de l'Académie d'Agriculture de France, 1918.

Annuaire de l'Institut de France, 1922.

Aucoc, Léon: "L'Institut de France." A compilation of the laws, statutes and regulations, from 1635 to 1889, with the chronology.

Boissier, Darboux, Perrot, Picot, Roujin and Franklin: "L'Institut de France." 1907.

De Franqueville, Comte de: "Le Premier Siècle de l'Institut de France." Biographical notices of members, compilation of laws, etc., covering the period October 25, 1795, to October 25, 1895.

Lemaistre, A.: "L'Institut de France et Nos Grands Etablissements Scientifiques." 1896. Discusses the Institut, Collège de France, Jardin des Plantes and Museums, Sorbonne, Observatory and Institut Pasteur.

Tassy, E., and Léris, P.: "Les Ressources du Travail Intellectuel en France." 1921. A list of the French universities, libraries, educational organizations, societies, etc. No historical comment. Published by Gauthier-Villars et Cie., 55 Quai des Grands-Augustins, Paris.

RECENT WORK IN PALEOBOTANY

As chairman of the Committee on Paleobotany in the Division of Geology and Geography of the National Research Council, David White has recently submitted a brief preliminary report which should interest some who are not students of paleobotany. This subject which is sometimes thought to come perilously near to "pure science" is seen to have more points of contact than has been casually assumed. Some of these contacts are with business and industry.

A most interesting feature of recent paleobotanical research is the extended application of the microscope to the study of carbonaceous deposits, including carbonized plant fragments. Consequent on the development of this technique, Dr. Reinhardt Thiessen has made special studies not only of the spores in oil shales, but of spores found in bituminous coals. It would appear that some of the coal beds of the Appalachian Paleozoic are characterized, and may be identified, by some of the types of megaspores entering into the coal composition. Incidentally, the improved technique developed by Thiessen, by Professor E. C. Jeffrey and Miss T. Stadnichenko, who for a time assisted David White in the Geological Survey, assures great progress in the better understanding of the plant debris and products entering into the composition of coals and oil shales, affecting their initial character, and, subject to metamorphic modification, determining their uses and possibilities. Jeffrey has achieved new successes in making transparent sections of anthracite as well as of high rank bituminous coals, so as to reveal in marvelous detail the structure and present condition of the organic matter. In fact Jeffrey's accomplishments in the histological and morphological demonstration of carbonized plant fragments has opened an essentially new field of the greatest importance in paleobotany. In view of the abundance of carbonized plant debris as compared with the regrettable rarity of petrified material, the ability to study the former successfully marks a greater advance in paleobotany.

The study of fossil diatoms which has been greatly stimulated by the work of Dr. Albert Mann of the Carnegie Institution on the deposits in the Pacific Coast Tertiary, as well as in other areas, is arousing considerable interest. A number of paleontologists have thereby been encouraged to examine some of the Tertiary shales of California under the microscope, with consequent discoveries which may aid materially in revising the stratigraphic classification and also in locating new oil pools in southern California. This means that new investigators are entering upon studies along the lines of research to which Dr. Mann has given a large part of his life.

Much of the study here mentioned lies in the field of what might be called *organic geochemistry* and bears on the general question of the origin and classification of coal and oil shales. Investigation may be stimulated by economic interests but does not depend on these for its justification. But even if both the search for and the classification of coal and oil shale should for the present ignore the microscopic remains of life, it is probably safe to forecast that the laws of origin when properly known will shed light on the distribution just as has been the case with ore deposits.

A considerable increase is observed in the amount of university instruction in paleobotany in the last year or two, notably at Chicago, Michigan and the New York Botanical Garden. In the last named institution Dr. Arthur Hollick occupies a new position carrying the title of paleobotanist and will conduct graduate work in connection with Columbia University.

The report calls attention to certain parts of the field of paleobotany, supposedly fertile and promising, yet remaining almost uncultivated. Little attention has yet been given to the micro-
at the Jardin des Plan esidues, meaning the
Many courses are given e different structural
which are those on a ucts found under the
phytes and zoology (b nd coals, with deduc-
tio School of Botany al composition of this
de Jardin [illegible] position. Micro-chemistry
also es attention to the effects of regulated
heat on the different organic components of
the rock, noting their changes and the products generated. It is hoped that experimentation

along these lines will be expanded, for it should contribute much to our knowledge not only of the origin of coals and oil shales, but of petroleum. Such studies have an important bearing, also, on the rôle of these components in the production of artificial petroleums of different types. Similar or analogous studies should be made of peats and richly organic mud deposits now forming. "A pitifully small number are engaged in the study of the paleontology and conditions of origin of peats, and still less interest is taken in the paleontology of the bituminous muds now depositing to form the mother substance of petroleum in a future epoch." No one can guarantee that money given for such researches would be the means of bringing to light new principles of practical value to the oil man, but in the light of past advances in science and industry it would be safer to believe that than the opposite.

It is with peculiar timeliness that Dr. Slosson now reminds us that Bacon, after giving other and more evident reasons for investigation, commends experiments without other provocation or justification than that they have never been tried before. The shock comes when we note the concrete thing he suggests, to illustrate such otherwise purposeless adventures or "experiments of a madman." "But of what I may call close distillation no man has yet made trial. Yet it seems probable that the force of heat, if it can perform its exploits of alteration within the enclosures of the body, where there is neither loss of the body nor yet means of escape, will succeed at last in handcuffing this Proteus of matter and driving it to many transformations." Little did Bacon know what this proposed adventure in *destructive distillation* would some day give to the world in coke and gas and coal-tar products and the cracking process and gasoline and dividends. So much for what Bacon called experiments of *Light*. "And it must ever be kept in mind (as I am continually urging) that experiments of Light are even more to be sought after than experiments of Fruit."

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SCIENTIFIC EVENTS

THE OLD ASHMOLEAN MUSEUM AT OXFORD

R. F. GUNTHER, of Magdalen College, Oxford, writes to the London *Times* under date of November 25, as follows:

What is to be done with the Old Ashmolean?

After the Bodleian, the Ashmolean is more widely known than any other university institution. And justly so, for Elias Ashmole, by bringing the contents of Tradescant's London Museum to Oxford, became the founder of the first public museum of natural history in Great Britain. That the scientific collections of Ashmole might be shown in a manner worthy of them, the university erected what is now known as the Old Ashmolean Building, which included a chemical laboratory. It was opened with great ceremony in 1683. For a hundred and fifty years the specimens were to be seen there, and became historic; but when, in the Victorian period, they were scattered among the new museums, many disappeared, and their seventeenth-century association with the old museum was lost.

The building is a fine one, built in the time, and perhaps under the supervision, of Wren. The well-proportioned rooms designed for a public museum are not now much visited by the public. For a number of years they have been used as offices for a succession of praiseworthy undertakings. Some are now empty, and the tenure of the last of the temporary tenants, the staff of the New English Dictionary, is approaching an end. The question arises, What is to be done with the Old Ashmolean?

One proposal is to fill it with books, and to use it as an adjunct to the Bodleian, which is casting covetous eyes on the Divinity School, the Old Clarendon Building, the Sheldonian Theater, the Convocation House, even on Exeter College, and on all adjacent buildings—without doubt it could fill them all.

But, according to another view, the answer is clear. The Ashmolean Museum was built for the collections of Ashmole and Tradescant. These collections should be restored to their ancient home; and to her great public library and the oldest Botanic Garden in Great Britain, Oxford would add the oldest public museum of this country in its original building. Visitors from overseas would find here one more link with the past.

At the present moment a compact and exceedingly valuable collection of ancient scientific instruments of great rarity, and of greater intrinsic worth than the contents of Tradescant's Ark, is being offered as a gift to the University by Mr. Lewis Evans, F.S.A. The new museums in Oxford have regretfully declined the offer, owing to lack of space. The upper rooms of the Old Ashmolean are standing empty. Mr. Evans's gift is conditional upon his instruments being properly displayed. Their acquisition, in addition to those instruments which are already in the possession of the colleges, would certainly put Oxford in a preeminent position.

When it is remembered that, in the fourteenth and again in the seventeenth centuries, Oxford was the principal home of British science, and that the Ashmolean was a child of the Scientific Renaissance, and for a century and a half the center of the scientific life of Oxford, there is a greater appropriateness in these Oxford collections of early scientific instruments and specimens going there than anywhere else in the world.

THE NATIONAL OFFICE OF EUGENICS IN BELGIUM

According to the *Eugenical News*, there was inaugurated at Bruxelles a Belgian National Office of Eugenics. This occupies one of the small rooms of the Solvay Institute of Sociology, situated in the charming Parc Léopold of that city. The director of the new Office is Dr. A. Govaerts, who is as[illegible] Mr. W. Schraenen, an anthropological assistant to Dr. L. Vervaeck, physician of the prison. It is understood that the Institute Solvay has made an appropriation of 10,000 fr. and that Mr. Armand Solvay will make a personal gift of 7,000 fr. Among those who have been instrumental in the establishment of the office may be mentioned, first of all, Dr. M. F. Boulenger, director of the School of the Feeble-Minded at Waterloo and president of the Société Belge d'Eugénique; M. Berryer, Minister of the Interior and of Hygiene; the surgeon general of the Belgian Army, Willemaerts; Col. Noterman, head of the Army Institute of Physical Military Training; H. Velghe, director general of hygiene in the Department of the Interior; M. Dom, director general of justice; M. Vandervelde, Minister of State; M. Wittemans, senator; M. Gheude, senator of the Province of Brabant; Dr. Bayet, member of the Royal Academy of Medicine; M. Brunet, president of the House of Representatives; Professor Demoor, delegate of the Academy of Medicine; M. Hostelet, director of the Solvay Institute of Sociology. Others who participated in social affairs connected with the congress were Dr. and Mrs. Leclerc-Dandoy, of the University; Professor Ley; Dr. Péchère, Dr. R. Sand and the Rev. Père Fallon. At the meeting of the International Commission in Antwerp the mayor of the city announced that an appropriation had been made for a branch office of the National Office of Eugenics, to be located at Antwerp.

SIR EDWARD SHARPEY SCHAFER, F.R.S.

Some time ago the suggestion was made that the meeting of the British Association in Edinburgh in 1921 would form a fitting occasion for the presentation to Sir Edward Sharpey Schafer of some token of their esteem from his present and past demonstrators and fellow research workers first in London and afterwards in Edinburgh.

As so many of those who had been trained under him now occupy posts in distant lands it was found impossible to make the necessary arrangements for the presentation at that early date, but Professor Halliburton made a statement at one of the largely attended meetings of the Physiology Section, expressing the desire of all who had been associated with their old master in the prosecution of physiological research to present him with some mark of their esteem and affection, and indicating the form it would probably take. It was appropriate that the announcement should be made in Edinburgh, for Sir Edward Sharpey Schafer has been professor of physiology there since 1899.

It was decided that the presentation should consist of a life-size portrait plaque, and that a medal reproducing the portrait and inscription should be offered to each of the many subscribers. The plaque and the medal are the work of Mr. C. d'O. Pilkington Jackson, A.R.B.A., and the portrait is excellent. The obverse bears in bold relief the bust of Sir Edward Sharpey Schafer, and the reverse contains a dedicatory inscription. The plaque itself is of bronze and has been mounted on stone with the inscription shown on the reverse of the medal underneath it. At Sir Edward Sharpey Schafer's desire it will eventually be placed within the University of Edinburgh, but at present it remains in the sculptor's studio, as he wishes to exhibit it at the Royal Scottish Academy.

The long list of subscribers includes many of the leaders in physiology and other branches of medical science in this and other lands: a few of them may be named—Bayliss, Rose Bradford, Halliburton, L. Hill, MacWilliam, Mott, Starling, in Great Britain; and Hunter and Tait (Canada), Jolly (S. Africa), Malcolm and Mackenzie (New Zealand), Addis and S. Simpson (U. S. A.), Row (India), Itagaki and others (Japan). Among the original subscribers were two of great distinction who have unfortunately passed away—Augustus Waller and Benjamin Moore.

The profession will join in congratulating Sir Edward Sharpey Schafer on this spontaneous tribute from his old pupils and fellow workers to his eminence as a physiologist, and to the inspiration of his teaching, and also in the hope that he still has before him many years of successful work.

THE INTERNATIONAL CONFERENCE ON THE STANDARDIZATION OF SERUMS

Dr. Augustus B. Wadsworth, director of the division of laboratories and research of the New York State Department of Health, has returned to Albany from Paris, where he represented the Rockefeller Institute on the international committee appointed by the League of Nations to standardize serums for the treatment and prevention of pneumonia, meningitis, diphtheria and other diseases. Dr. Wadsworth makes the following statement in regard to the work of this committee:

> The Second International Conference on the Standardization of Serums and Serological Tests of the Health Committee was held under the auspices of the League of Nations, November 20 to 26 inclusive, at the Pasteur Institute in Paris. Professor Theodore Madsen, president of the Health Section of the League of Nations, presided at the conference. Opening addresses were made by Dr. Roux, the discoverer of diphtheria toxin, and the French minister. It is noteworthy that the invitations were extended by the Pasteur Institute and that in the interests of science and humanity the representatives of nine different nations found common ground for this first meeting on French soil. We all shared and enjoyed alike the cordial hospitality of the French scientists.
>
> Immediately after convening the members of the conference were assigned to committees to facilitate the business. Professor Jules Bordet, director of the Pasteur Institute in Brussels, was appointed chairman of the sub-committee on serological tests; Professor Louis Martin of the Pasteur Institute, of the sub-committee on the standardization of tetanus and diphtheria antitoxin; Professor Cantacuzene, of Bucharest, of the sub-committee on antidysentery serum; Professor Neufeld, director of the Robert Koch Institute in Berlin, of the sub-committee on antipneumococcus serum. I was assigned to three of the sub-committees and served as chairman of the sub-committee on the standardization of antimeningococcus serum.
>
> Progress toward international standardization of serums and serological tests is necessarily a slow one because of the differences in the methods that are used in the several countries, but for this reason the importance and practical value of the work is all the more apparent. Despite the many different points of view, the practical results from the free discussion were most encouraging. If such conferences can be repeated it is not difficult to understand that the ultimate results in improvement of methods used throughout the civilized world will be of the greatest significance for humanity.

SCIENTIFIC NOTES AND NEWS

Dr. W. W. Campbell, director of the Lick Observatory, Mount Hamilton, California, on January 4 was unanimously named president of the University of California by the University Board of Regents. He succeeds Dr. Davis Prescott Barrows at the end of the present college semester. The regents agreed to a proposal by Dr. Campbell that he remain as a director of the Lick Observatory as a "dollar a year" man. He will take office on July 1, when Dr. Barrows will become professor of political science.

Dr. Samuel Wesley Stratton, director of the Bureau of Standards, was the guest of honor at a farewell reception at the bureau on December 14. The program included an exhibit of the work of the bureau and a visit to a number of the industrial laboratories. Dr. Stratton was presented with a silver service from the members of the staff.

Professor G. A. Miller of the University of Illinois was reelected a member of the council of the American Association for the Advancement of Science at the Boston meeting, and Professor H. L. Fairchild of the University of Rochester was elected to the council. Dr. J. McKeen Cattell, editor of SCIENCE, and Dr. Henry B. Ward of the University of Illinois were reelected members of the executive committee of the council. Professor Frank Schlesinger, of Yale University, and Professor W. D. Harkins, of the University of Chicago, were chosen members of the committee on grants, which apportions the income of the association to advance scientific research, Professor Schlesinger being chosen to represent astronomy and mathematics, and Professor Harkins to represent chemistry.

PROFESSOR CHARLES E. MENDENHALL, of the University of Wisconsin, has been elected president of the American Physical Society for the year 1923 to succeed Professor Theodore Lyman, of Harvard University.

THE Ecological Society of America at the Boston meeting elected as its president, Dr. C. C. Adams, of the New York State College of Forestry, Syracuse, N. Y.; as vice-president, Dr. G. A. Pearson, of Fort Valley Experiment Station, Flagstaff, Ariz., and as secretary-treasurer, A. O. Weese of James Milliken University, Decatur, Ill.

DR. G. R. LYMAN, of the Bureau of Plant Industry, Washington, has been elected president of the American Phytopathological Society; Dr. F. D. Fromme, of the Virginia Agricultural Experiment Station, vice-president; and Dr. R. J. Haskell of the Department of Agriculture, Washington, secretary-treasurer.

THE Society of Economic Geologists elected at the annual meeting the following officers: J. E. Spurr of New York, *president;* Professor Andrew C. Lawson, of the University of California, *vice-president; directors,* Dr. L. C. Graton, of Harvard University; Dr. Ralph Arnold, of Los Angeles and New York, and Willet G. Miller, of Toronto, Canada.

AT the meeting of the Mineralogical Society of America held at Ann Arbor, Mich., on December 28, 29 and 30, the following officers were elected: For *president,* Dr. Edgar T. Wherry, Bureau of Chemistry, Washington, D. C.; for *vice-president,* Dr. George Frederick Kunz, New York City; for *secretary,* Frank R. Van Horn, Case School of Applied Science, Cleveland, O.; for *treasurer,* Albert B. Peck, University of Michigan, for *editor,* Walter F. Hunt, University of Michigan; for *councilor* 1923-26, Esper S. Larsen, U. S. Geological Survey, Washington, D. C.

THE Perkin medal of the New York Section of the American Chemical Society will be presented to Dr. Milton C. Whitaker, chemical engineer of New York City, at the regular meeting of the section at the Chemists' Club, on the evening of January 12. The following program has been arranged: "Introductory remarks," by Professor Ralph H. McKee; "Impressions," by Dr. A. A. Bachaus; "Whitaker and his Work," by Dr. Arthur D. Little; "Presentation," by Professor Charles F. Chandler; "Acceptance," by Dr. Milton D. Whitaker.

THROUGH an official representative Belgium has dedicated at Stanford University at Palo Alto, Calif., a bronze statue in recognition of the services rendered to that country during the war by Secretary Hoover, who is a graduate of the California institution.

PRINCE GELASIO CAETANI, an engineer by profession, has been appointed Italian Ambassador at Washington. A dinner has been planned in his honor by the American Engineering Council of the Federated American Engineering Societies in Washington on the evening of January 12.

DR. W. HELLPACH, professor of psychology at the Technological School at Karlsruhe, has been appointed *Kulturminister* for the state of Baden.

AT a meeting of the court of the University of Leeds profound regret was expressed at the retirement of Professor Smithells, after thirty-seven years' service as head of the chemistry department, to devote himself to scientific investigation in London.

GENERAL C. G. BRUCE and Colonel E. L. Strutt, of the Mount Everest Expedition, were given an official reception on December 15 in the Sorbonne, Paris, by the French Geographical Society and the French Alpine Club.

DR. N. H. DARTON, of the U. S. Geological Survey, has returned to Washington after nearly two years' field work completing the geologic map of Arizona for the State Bureau of Mines. While Mr. Darton was in Arizona the State University conferred on him the honorary degree of doctor of science in recognition of his work on the geology of the southwest.

DR. CHARLES LANE POOR, professor of celestial mechanics in Columbia University, has been granted leave of absence for the second half-year. In January Dr. Poor will sail for South America, where he will visit Arequipa and other observatories.

DR. E. S. HANDY, ethnologist and Mrs. Willowdean Chatterton Handy, associate in Polynesian folk ways of the Bishop Museum staff, left Honolulu early in January to continue their researches in Polynesian native culture. After a short stay in New Zealand they will proceed to Taluti, where their work for the present year will be centered.

E. A. S. CLARKE, lately president of the Consolidated Steel Corporation, has been elected secretary of the American Iron and Steel Institute.

JOHN MORRIS WEISS, until recently director of development of The Barrett Company, and Charles Raymond Downs, formerly chief chemist of the Barrett Company, and more recently engaged in special plant development work at the Buffalo plant of the National Aniline and Chemical Company, have formed a partnership as consulting chemists and chemical engineers with an office in the Chemists' Building, New York City.

THE seventeenth annual dinner and reunion of the Cornell Society of Engineers will be held at the Fifth Avenue Restaurant, 200 Fifth Avenue, New York, January 19. President Livingston Farrand and Dean Dexter S. Kimball will speak.

DR. BÉLA SCHICK, professor of pediatrics at the University of Vienna, will deliver the fifth Harvey Society Lecture at the New York Academy of Medicine on Saturday evening, January 27. His subject will be "The Prevention of Diphtheria."

THE Mann Juvenile Lectures of the Royal Society of Arts were delivered on January 3 and 10 by Mr. C. R. Darling who spoke on "The Spectrum, its colors, lines and invisible parts, and some of its industrial applications."

THE Swiney lectures on geology, twelve in number, in connection with the British Museum (Natural History), are being delivered at the Royal College of Science, South Kensington, by Professor T. J. Jehu, who has chosen as his subject "Fossils and what they teach."

THE centenary of the birth of Pasteur was celebrated by the Town and Gown Club, Austin, Texas, on the evening of December 21, 1922. The address on "Louis Pasteur, his life and his contributions to science and to humanity" was delivered by Dr. Henry Winston Harper, of the University of Texas.

A STATED meeting of the American Philosophical Society was held on Friday evening, January 5, in Philadelphia to commemorate the centenary of Louis Pasteur. Lawrence J. Henderson, M. D., professor of biological chemistry at Harvard University, delivered an address on "The Life and Services of Louis Pasteur."

A JOINT meeting of the New York Sections of the American Chemical Society and of the Société de Chimie Industrielle was held on January 5 at the Chemists' Club, New York City. A special program was arranged commemorating the centenary of the birth of Louis Pasteur. Speakers were as follows: Professor Gary N. Calkins of Columbia University; "Pasteur and the Science of Fermentation," Professor John M. Nelson of Columbia University; "Pasteur and Chemical Asymmetry." Dr. John W. Churchman of Cornell University Medical School spoke on "The Selective Bacteriostatic Properties of Certain Dyes."

MRS. MABEL HUBBARD BELL, widow of Alexander Graham Bell, died on January 3 at the residence of her daughter, Mrs. David Fairchild at Chevy Chase, Md. Mrs. Bell never recovered from the shock of her husband's death last August. She became completely deaf after an attack of scarlet fever suffered at the age of three years. It was in part through this circumstance that Mr. Bell made the experiments on phonetics that resulted in the invention of the telephone, and it was with the cooperation of Mr. Hubbard, Mrs. Bell's father, that the practical development was carried out. It will also be remembered that Mr. Bell largely occupied himself with work for the relief of the deaf.

At the second assembly of the League of Nations it was decided that cooperation among intellectuels in different countries of the world was a necessary step towards universal peace, and a Commission on Intellectual Cooperation was formed. A meeting of the three subcommittees of this commission, which includes, amongst others, Professor Einstein, Mme. Curie, Professor Bergson, M. Jules Destrée (former Belgian Minister for Science and Arts), and Professor Gilbert Murray, opened in December in Paris. The first sub-committee deals with bibliography, and consists of Professor Bergson, Mme. Curie, and M. Destrée. Amongst others it has coopted Dr. Hagberg Wright (director of the London Library). One of its aims is to institute an international bibliographical bulletin and scientific review. It will also discuss the possibility of forming one or several large international libraries at which all books published in all countries will have to be deposited.

A mission of ten graduates of the engineering schools of Egypt has been sent to America by the Egyptian government to study manufacturing methods in this country. They have been placed in various factories by the Department of Commerce and will work as employees while they are acquiring a knowledge of American methods and machine-shop equipment.

Dr. Carl Skuttsberg, director of the Botanical Garden, Gothenburg, Sweden, and Bishop Museum fellow in Yale University, has completed his field work in Hawaii. Under the guidance of Dr. H. L. Lyon and of other local scientific men, Dr. Skuttsberg made a survey of four islands, with special reference to a comparison of Hawaiian endemic types with those of Juan Fernandez islands and with Alpine flora. The results of his studies will appear among the publications of the Bishop Museum.

The material collected at Palmyra Island and Kingman Reef by a party consisting of Lorrin A. Thurston, David Thanum, Manuel Vasconcellos and Theodore Dranga is said to be of considerable interest to students of the natural history of the Pacific. The primary purpose of the members of the expedition was obtaining sea shells for their private collections, but there were also obtained for the Bishop Museum representative series of crustacea and echinoderms, some land shells and insects, and many species of fish,[*] some of them new to science. A special study was made of the giant Coconut crab, *Birgus latro*.

Dr. S. C. Ball and Professor C. H. Edmondson have submitted to the Bishop Museum a preliminary report of their expedition to Fanning Island, lying about 1,000 miles south of Hawaii. A fairly complete natural history survey of the island and its reefs was carried out. Marine crustacea and echinoderms were found in abundance and a considerable collection of marine molluscs was obtained. The predominant terrestrial animal on all islands of the group is the land crab, *Cardisoma carnifex*, present in hundreds of thousands. One object of the visit was to secure specimens of the two land birds, a paroquet, *Coriphylus kuhli*, and a warbler, *Tartare sp.* The former was found abundant, but the latter less so. Skins and photographs of nine sea and shore birds living on Fanning were also secured. The party brought back 21 species of plants, 50 species of insects, in addition to fishes and lizards. There was little of ethnological interest to be obtained. The expedition was made possible through the courtesy of the Pacific Cable Board, which granted the use of the schooner H. M. S. *Tangaroa* (Captain Menmuir). The staff of the cable station and the officers of the local Copra Company contributed much to the success of the work.

The Forest School of Yale University is the recipient of a valuable table from the Philippine Islands, the gift of the alumni of the school who are employed in the Philippine Forest Service. This table is of Narra wood, 5 feet by 18 feet in size. It was originally presented by the old Spanish Forestry Bureau, known as the Manila Botanical Garden, to the mayor and council of Manila in 1886. After the American occupation the table was used for some time by Governor General William Howard Taft. When Mr. Taft left, it passed into private hands and was recently acquired by the director of the Philippine Forest Service, Arthur F. Fischer, and other Yale alumni. The table is inlaid with an inscription in Camagon wood denoting its origin and disposition. Forty-six kinds of Philippine woods were used to manufacture the table; each sample is numbered and identified for addition to the school collection, which has for many years been the largest of its kind in the United States. The table will be used in the new forestry building, Sage Hall, the gift of William H. Sage, Yale, '65, which is being erected on Pierson-Sage Square and will be completed during the coming summer.

WITH a view toward putting temperance work in Japan on a sounder basis through the use of fact rather than opinion or sentiment, a chair of alcohol research is to be established at one of the Japanese universities. To this end Mr. Shyozo Aoki, of Tokyo, a retired merchant of Osaka, has established a foundation known as the Aoki Kyoseikae (Reform Society), granting to it the sum of 100,000 yen ($50,000), to be used in placing in one of the universities of Japan a chair of alcohol research. This decision results from efforts of the American Association for Alcohol Research, founded in 1921 by Captain Richmond P. Hobson, now seeking a similar endowment for a chair of alcohol research in an American university.

A DESPATCH from Toronto to the London *Times* reports that Sir Robert Falconer, president of the University of Toronto, in answer to British criticism, says that "insulin," the recently discovered gland extract for use in the treatment of diabetes, has been patented for one reason only—the protection of the public. It is a means of making certain that the extract will always be of proper strength for effective use. Professor Macleod, for the medical faculty, explains that if the university had not patented "insulin," some commercial company would have done so, and obtained a monopoly. "The holding of the patents has already justified itself in permitting the university to undertake large-scale production so as to work out thoroughly satisfactory methods for the production of uniform potency and minimum toxicity." The university authorities hope that "insulin" will be freely supplied to physicians in general practice early next year.

THE Department of Commerce announces that the compilations made by the Bureau of the Census show that 1,032,009 deaths occurred in 1921 within the death registration area of continental United States, representing a death rate of 11.6 per 1,000 population as compared with 13.1 in 1920. The rate for 1921 is the lowest rate recorded in any year since the beginning of the annual compilations in 1900. The death registration area (exclusive of the Territory of Hawaii) in 1921 comprised 34 states, the District of Columbia, and 16 cities in non registration states, with a total estimated population on July 1 of 88,667,662, or 82.2 per cent. of the estimated population of the United States. The death rate from cancer increased from 83.4 per 100,000 in 1920 to 86 in 1921. Some of the other diseases for which the rates increased are diphtheria, typhoid fever, appendicitis, scarlet fever, diabetes and puerperal fever. The fatalities caused by automobile accidents and injuries show an increase from 10.4 per 100,000 in 1920 to 11.5 in 1921. A marked decrease is shown in the death rate from tuberculosis, which was 99.4 in 1921 as compared with 114.2 in 1920; also in the death rate from influenza and pneumonia (all forms) which was 99.8 in 1921 against 208.3 in 1920. The rates for measles, nephritis, bronchitis, whooping cough, heart disease and diarrhea and enteritis also declined.

THE first meeting in the interest of applied psychology, held in Berlin recently, was organized by the group for applied psychology, made up of members of the Gesellchaft für experimentelle Psychologie. The correspondent of the *Journal* of the American Medical Association reports that of the many fields of application of psychology, only one was considered at this meeting; namely, industrial or vocational psychology, which, dealing with psychotechnical procedures for establishing experimentally the qualifications of applicants for industrial positions, has awakened, since the war, marked public interest. During the intervals between transactions, opportunity was given to inspect the psychotechnical apparatus of various industrial plants. The first part of the session was devoted to the exhibition of the many psychotechnical methods used in establishing various findings of industrial significance. At the close of the session, a resolution was adopted to the effect that all persons who, in an official capacity, have to do with vocational guidance should accord to psychology the important place it deserves.

THE Boston *Transcript* writes: "Colonel E.

Lester Jones, director of the Coast and Geodetic Survey, wanted the modest sum of $40,000 to enable him to complete wire drag work on the North Atlantic seaboard. General Lord, director of the budget, cut the item out of the appropriation bill, and now Representative Shreve, of Pennsylvania, chairman of a subcommittee on appropriations, declares himself incapable of overriding the decision of General Lord. This means that unless the maritime interests can bring sufficient pressure to bear on the committee on appropriations or General Lord or both wire-drag work extending practically from Newburyport along the Maine coast to the Canadian line must be abandoned. The Coast Survey has performed a remarkable service in clearing coastal waters of the boulders which infest them, most of them unknown, and yet many almost directly in the path of coastwise shipping. It will be recalled that a few years ago off Boston harbor one of the great battleships came within something like fifteen feet of striking a hidden rock that might easily have torn her side open and let her go down into one hundred feet of water. A little later it was necessary to wire drag Salem harbor to permit the entrance of another battleship, and twenty-five boulders were removed during the process. The work had proceeded as far as Newburyport harbor, and Colonel Jones estimated that with the new and improved drags he is using $40,000 would enable him to clear the whole American coast. The work must be done eventually, and the appropriation officials may have a hard time explaining why it is being delayed."

UNIVERSITY AND EDUCATIONAL NOTES

The Philadelphia College of Pharmacy and Science is endeavoring to raise $2,000,000 for expansion of its work, and has already raised the sum necessary for a building site, which has been purchased. It is planned to use the $2,000,000 for a group of buildings, with equipment, and in providing an adequate endowment. Rear Admiral W. C. Braisted, formerly surgeon general of the Navy, is the president of the college.

Bates College has received an anonymous gift of $60,000 toward its million-dollar endowment fund. Including the $200,000 conditionally promised by the General Education Board, this brings the fund total to $550,000.

The University of Glasgow has received a gift of £25,500 from Mr. Henry Mechan, of Mechans, Limited, engineers and contractors, Glasgow, for the foundation of a new chair of public health.

On the death, recently, of Mr. Gemmell, brother of the late Dr. Samson Gemmell, regius professor of medicine in the University of Glasgow, the fortune which passed to him on the death of Dr. Gemmell, amounting to approximately £100,000, has been bequeathed to various Glasgow institutions. The sum of £20,000 is left to the trustees of the university for the purpose of endowing a chair in the faculty of medicine or science, to be known as the Samson Gemmell chair. The choice of subject is left to the trustees.

At Clark University Assistant Professor C. E. Melville has been promoted to a full professorship of mathematics.

Dr. A. E. Young, professor of mathematics at Miami University, has resigned to accept position with the Standard Oil Company at Pittsburgh.

Dr. Hugh S. Taylor has been promoted by the trustees of Princeton University to a full professorship in the department of chemistry, with the title of professor of physical chemistry.

W. W. Rubey, assistant geologist of the U. S. Geological Survey, has been granted leave of absence to accept an instructorship at Yale University for the current year.

DISCUSSION AND CORRESPONDENCE

A PROPOSAL FOR WILD PLANT CONSERVATION

The state of Vermont, well noted for rare plants—ferns and flowers—in considerable abundance, recently awoke to the fact that its flora was threatened with extinction. Plants formerly abundant were becoming rare and some rare plants were disappearing from localities where they had been fairly frequent. This applied particularly to various species of orchids and alpine plants with which Vermont had been rather abundantly supplied.

Investigation pointed to the commercial collectors of live plants as responsible. For such transplantation, it was suggested that the plants would beautify grounds and gardens, and would, perhaps, delight a greater number of people than if they remained in the Vermont woods. Against this, it is to be noted, first, that a high percentage, especially of orchids and alpines, would die in moving. Even arbutus, one of the most difficult wild plants for transplanting, has been offered for sale. A second point lies in the fact that a considerable number of disappearing forms are capable of rather easy and economic artificial propagation. For example, the Goldie Fern and others may be readily grown from spores under cool greenhouse conditions, and the plants so produced are in much better condition for transplanting than specimens pulled up by the roots from the wild. In other words, it is not necessary to deplete the wild supply of such plants in order to supply the market.

In any event, Vermont decided that it wished to keep its own, to maintain its wild flora in approximately its original condition. Under the leadership of the Vermont Botanical Society, a first general game law for plants was drawn up, and in 1921 was passed by the Vermont legislature. This law provides that a specified list of rare plants shall be established as a protected list, and may not be collected for commercial exploitation. Further, botanists are restricted to two specimens per season of the plants named in the list.

The Vermont Law has been made the text of an article in the "American Fern Journal" for September, 1922, in which the action of Vermont is cited as an example worthy of imitation. Other states are also losing large numbers of their rare plants. It is suggested in this article that each state should first study its own situation and then draw up a list of the plants within its borders which seem most in need of protection.

The article further suggests that another type of protection will be necessary in the case of particular species which grow in swamps or other regions threatened by agricultural or industrial development. For example, the climbing fern, common in a few places in Connecticut, and for which the first law protecting plants was passed thirty or forty years ago, is now threatened by the fact that its habitats are desirable places for the cultivation of tobacco. The rare hart's tongue fern, in its best locality in central New York, is threatened by quarrying interests. The only way by which such plants as these can be protected is by the establishment of reservations or sanctuaries of the nature of wild natural gardens.

The "Fern Journal" article, above mentioned, has been reprinted for general distribution throughout the country in the hope that it may reach organizations and individuals in various states who would be interested to start action in their states similar to that taken in Vermont. For this purpose the original article has been somewhat revised and has been reprinted with cover pages, and with additional illustrations of rare plants. Sample copies will be sent to those interested by application to Dr. R. C. Benedict, Brooklyn Botanic Garden, Brooklyn, New York. The type of the reprint has been held for reprinting so that any organization interested may be able to order additional copies at printer's prices. Arrangements have been made to deposit the type plates with Mr. P. L. Ricker, secretary-treasurer of the Washington chapter of the Wild Flower Preservation Society, and future orders will be procurable through him as required.

It may be objected by someone that such a law, without enforcing machinery, is useless and even undesirable, but the fact remains that the original climbing-fern law, to which the same objection might have been raised, was apparently effective in protecting the plant from extinction. Again the necessary community action incident to the study of the situation leading to the proposal of such a law would be highly educative to the people at large, and if a number of states should undertake joint or simultaneous action, the desired result of restricting a mischievous and unnecessary depletion of rare native wild plants would probably be achieved. The Brooklyn Botanic Garden is cooperating with the Fern Society to the extent of ordering and distributing one thousand copies of the first reprinting of the article.

C. STUART GAGER

THAT CHEMICAL SPELLING MATCH AGAIN

So much has been said and written about this subject since my first note appeared in SCIENCE September 29, that I am going to make a further suggestion along the same line.

Requests have come from different universities for details regarding the match, as well as for a list of chemical formulæ which we used in connection with our spelling match. Only one such list could be supplied, however, but if enough interest is aroused in the matter, I shall endeavor to prepare a much larger and more comprehensive list, which might eventually be published in book form.

Much valuable information about a substance is contained in its chemical formula. Therefore, the ability to ascribe the right formula to a given substance, without consulting the literature, is an accomplishment coveted by all chemists.

Formerly competition was the life of trade, but this desirable quality has gradually disappeared as the combining power of the traders developed. Competition, however, remains the motive power in the life of nearly every student, and the chemical spelling match offers one of the best opportunities for spectacular competition in the field of intellectual pursuits.

There is no danger of ever exhausting the supply of formulæ in any chemical spelling match. Even if the "walking encyclopedias" that we hear so much about should get into the contest they would doubtless be spelled down before the hundredth part of the words had been pronounced. Nevertheless, it would be interesting to know who the All-American champion chemical speller is.

Should the subject elicit sufficient interest the country could be divided into twenty-four or more districts and all higher institutions of learning within each district compete for first prize; and then for the semi-final contests the winners in the northwest districts would assemble and spell for the championship of the northwest, and in like manner a champion would be selected from the southwest, one from the southeast, one from the northeast, one from the north central, and one from the south central districts. These six winners in the semi-finals should then meet for the national championship battle.

Should the contests prove as interesting and valuable as anticipated, Canada, Great Britain and Australia might want to send representatives to the final matches. Eventually we might even go farther than this. The chemical formula is the same the world over, and there is no reason why chemistry students all over the world should not have an opportunity to compete for so unique an honor.

The general establishment of these contests would stimulate the study of chemistry everywhere, and would therefore mark a long step toward greater efficiency in teaching as well as research. The details of these spelling matches would of course be worked out as the subject develops. It would appear that, in the selection of the winners in both semi-final and final matches, no one should be declared a winner who had not won at least three out of five contests with his opponent.

We have our world's champion boxers, tennis players, scullers, runners, jumpers, vaulters, etc., and would it not be in keeping with the march of events to establish an intellectual event of this sort which combines the elements of sport and usefulness.

Spelling matches could not be supported by the gate receipts, and in order to defray the expenses of the contestants, other means of support would have to be provided. This and numerous other details would be handled by a committee. As chairman of such a committee I know of no one who would be more suitable than Dr. Edwin E. Slosson, of Washington, D. C.

If he would consent to serve in this capacity I should confer upon him this high office, with all the honors, rights and privileges thereunto appertaining.

Make the reward for this championship large enough and contestants will come from all the leading countries of the world. Aye, they would come

From Greenland's icy mountains,
And from India's coral strand;
From Africa's sunny fountains,"
And from Russia's benighted land.

WANTED—A Scientific sport who will establish a prize for the World's Championship in Chemical Spelling.

C. A. JACOBSON

MORGANTOWN, W. VA.

A SCIENTIFIC CLEARING HOUSE

A PERSONNEL file for American investigators in the biological and physical sciences and their related technologies has been established in Washington, D. C., by the Research Information Service of the National Research Council. This directory of living research workers now lists approximately 14,000 names. A report describing the whole project, with illustrations based upon the personnel records of American psychologists, has just been issued as Bulletin Number 22 of the Council.

When these files were started, some two years or more ago, it was believed that such a record of research workers throughout the country and their scientific activities would, when classified, be widely useful; and experience has shown that through the system installed, facts as to the characteristics, interests and research activities of investigators can be expeditiously assembled.

As now organized the personnel file contains records of investigators in the following major groups of science and technology: (1) Agriculture, (2) Animal biology, (3) Anthropology, (4) Astronomy, (5) Chemistry, (6) Economics and statistics, (7) Education, (8) Engineering, (9) Geology, (10) Geography, (11) Mathematics, (12) Medicine, (13) Plant biology, (14) Physics, (15) Psychology. Several of these groups have been further subdivided as need has arisen. The files of records for economics and statistics and for education remain to be developed, but the data for investigators in other fields are now in useful form.

The original records of these investigators are supplemented by a mechanical punch-card system (Findex). The original file, arranged alphabetically, is consulted for information about any investigator whose name is known; the mechanical file, classified by subject, is consulted for names of investigators having prescribed qualifications. Through this punch-card system it is the matter of but a moment to obtain from any of the major groups a list of people of specified age, experience, achievement, research interest, and so forth. By a single operation selections of names of those meeting any required research specification or combination of specifications can be made.

The usefulness of a comprehensive catalogue mechanically operated for obtaining names of specialists is almost too apparent to need mention. But the personnel file promises to function even more widely and efficiently as a clearing-house for research people who wish to communicate with one another about common or related problems. With a minimum of time and effort the Research Information Service has frequently been able to furnish a half dozen references to current investigations related to that being carried on by some isolated investigator. Such contacts bring mutual advantages and are in accordance with a growing movement to encourage coordination rather than duplication of research. The overlap of activity, too, in the various sciences makes evident the usefulness of such a central clearing-house.

A personnel service specializing in living sources of research information is no less important than a bibliographic service specializing in printed sources. Neither can replace the other but each has its place in helping to furnish a foundation for science and research. Both types of service are rendered by the Research Information Service. Those in need of either kind of assistance are invited to write to Research Information Service, 1701 Massachusetts Avenue, Washington, D. C.

HAROLD C. BINGHAM
ASSISTANT DIRECTOR,
RESEARCH INFORMATION SERVICE

QUOTATION

VOLUNTARY STUPIDITY

EXPRESSING the conviction that any legislation attempting to limit the teaching of the doctrine of evolution would be a "profound mistake," the American Association for the Advancement of Science, at its opening session on Tuesday, at Cambridge, Mass. (the seat of

Harvard College) went on record as affirming that no scientific generalization is more strongly supported by the thoroughly tested evidence than is that of organic evolution.

A scientific generalization, as we understand it, means a general truth based on the great mass of scientific data that has been compiled since science attained the exactness and definiteness that could make it the basis for reaching conclusions regarding the nature of life.

The men who form the association which has taken this action looking toward a public teaching of the doctrine which has been considered basic in the development of the system of knowledge are the best equipped students and minds in the country. If the lawyer is not to be accepted as authority in his field, if the jury which is called upon to determine cases can not accept the testimony of the experts in various lines which is laid before them in an effort to mete out justice; in a word, if the expert in any line is to be debarred, and his learning and studies discounted, then we have arrived at a point where further progress for the race is impossible. The men who are engaged in America, and the world over, for that matter, in endeavoring to build up a body of knowledge useful for the advancement of the race do not profit greatly by this labor. The fact is, they could do many other things that would bring them greater compensation. This being true, and the fact that life's blood is spent in an endeavor to gain information that will be of welfare to humanity, when considered, should at least make the general public pause and say these men have put forth their greatest efforts in attempting to gain knowledge. It is at least due them that we should weigh and consider what they would have us know.

We hold no brief for the particular doctrine, or as they call it "generalization" of evolution. If people choose to believe that they "sprang from monkeys" that is their affair. The old joke in which the man who voiced this belief was told by his hearer that evidently "he didn't spring very far" was probably as true of the one as the other man in the conversation.

The point lies here. What the best minds of the country believe and would teach, that is the thing which should be promulgated in schools. Those who know less are not the ones who should set themselves up as judges as to what the youth of the country should be taught. Two other things should be kept in mind. One is that the schools to-day are not principally engaged in pouring stuff into the noggin of the pupil. They are busily engaged in teaching him how he can learn things for himself. The other big thing to keep in mind is that beliefs and teachings are more or less a matter of fashion. Ideas and thoughts that are held for a period of years wane and are discredited, then again they come back into fashion and favor.

Only recently in North Carolina we have had a remarkable instance of the absurdity of the fight on evolution. At a state-wide denominational gathering in which one of the leaders in education in the state was expected to be grilled for his utterances on "evolution," he preached such an inspirational sermon as to carry the convention off its feet. The man who had digested the evolutionary theory had still not forgotten his Bible and his God.

So it must be with any body of educators who endeavor to teach the best that is known to the nation's young. Their mind must not be closed to great truths no matter from what source they may come. Their faith must not be so small as to be shaken by the "generalizations" of modern science.

We must still prove all things, and hold fast to that which is good. The way to accomplish that is by learning all that may be learned and not by rejecting all that can be rejected, else will it be said with the truth, that the blind lead the blind.—*The Asheville Advocate.*

DEVELOPED AND POTENTIAL WATER POWER OF THE UNITED STATES

In 1908 the Bureau of the Census made a special census of the developed water powers of the United States for the report of the National Conservation Commission (Senate Doc. 676, 60th Cong., 2nd session). The data collected were also published by the U. S. Geological Survey in Water-Supply Paper 234, "Papers on the conservation of water resources." This census showed that there were in the United States 31,537 water power plants of all sizes, whose water-wheel capacity was 5,356,680 horsepower. An examination of the returns indicated that many very small plants were included, as the records showed only 602 plants whose water-wheel capacity was more than 1,000 horsepower. The total capacity of these 602 plants was determined to be 3,900,000 horsepower, leaving 1,457,000 horsepower distributed among 30,935 plants, which thus had an average capacity of only 47 horsepower.

The U. S. Geological Survey, in 1921, made a compilation of data showing the developed water power in the United States in plants of 100 horsepower or more. The data were collected by district engineers of the Survey by correspondence or by personal visits to the plants. Information was furnished by the Census Bureau in regard to the total water power and number of plants in manufactures in the District of Columbia, Kentucky, Indiana, Virginia, Maryland, Delaware and West Virginia. The figures for Maine were furnished by the Maine Water Power Commission. The results of the compilation, which are shown in the accompanying table, are considered to be reliable. The figures given for some of the States, especially Massachusetts, New York, New Jersey, and some of the Southern States may be subject to revision on account of incomplete returns.

The table shows that at present there are in the United States 3,116 water-power plants of 100 horsepower or more, with a total capacity of installed water wheels of 7,852,948 horsepower. Of this total 79 per cent is in public-utility plants and 21 per cent in manufacturing plants. It is of interest to note that the census of 1908, which embraced plants of all sizes, included 10 times as many plants as the present report, which embraces only plants of 100 horsepower or more.

New York still maintains its position as the leading State in the amount of developed water power, with 1,291,857 horsepower; California is a close second, with 1,149,099 horsepower; Washington is third, with 454,356 horsepower; Maine closely follows in fourth place, with 449,614 horsepower, and Montana is fifth with 344,420 horsepower.

To permit a comparison of the developed water power with the total water-power resources a table is included showing the maximum and minimum potential water power of the United States. This table is based on estimates made by the U. S. Geological Survey in 1908 for the National Conservation Commission and revised by the Commissioner of Corporations for his report on water power developed in the United States, 1912, and by the U. S. Forest Service in 1916.

In comparing the figures of developed water power and potential water power for any State or group of States as given in these two tables, the basis for the data in the tables should be kept clearly in mind if gross and absurd errors are to be avoided. The potential water power of the United States was determined by dividing the rivers into sections of different lengths, the length depending on the slope of the channel, and the fall and flow of each section were determined from the best information available. With these factors the potential water power of each stream was determined on the assumption of an efficiency of 75 per cent. in the water wheels. The portions of the streams where the slope is so small that water power can probably never be profitably developed were not included.

The minimum potential water power is based on the average flow of the two seven-day periods of lowest flow in each year of record. This, of course, does not give the absolute minimum flow, but for all practical purposes potential water power based on this flow may be considered as continuous power. The maximum potential water power is based on the flow available for 50 per cent. of the time. The use of storage was not considered in making estimates of either minimum or maximum potential water power. The estimates of both the minimum and maximum potential water power are considered conservative.

It is the general practice in the construction of water-power plants to install hydraulic machinery capable of utilizing stream flow far in excess of the absolute minimum and much in excess of the flow used in determining the minimum potential water power as given in the table. This practice is forcibly brought out by comparing the minimum potential water power with the total capacity of water wheels installed in water-power plants in some of the

New England States. If all the water power of the United States were to be similarly developed, it would probably be necessary to install plants having three or four times the capacity of the estimated minimum potential water power as given in the table. This condition should be fully considered in estimating the amount of potential water power that may still be available in any State at the present time.

SPECIAL ARTICLES

THERMIONIC EFFECTS CAUSED BY ALKALI VAPORS IN VACUUM TUBES

A tungsten filament was mounted in a vacuum tube in the axis of a cylindrical anode consisting of three parts insulated from one another. In this way, on the guard ring principle, the electron emission from the central portion of the filament could be measured, so that effects due to the cooling by the leads were eliminated. With metallic cæsium in the tube at 25° C. the cæsium vapor forms an adsorbed film consisting of a single layer of atoms completely covering the filament even at filament temperatures of 600° K. or more. The stability of this film appears to be due to the fact that the electron affinity of a tungsten surface (Richardson work function, 4.52 volts) is *greater than that of cæsium ions* (ionizing potential, 3.90 volts). When a cæsium atom comes close to a tungsten surface, the tungsten thus robs the cæsium atom of its valence electron and leaves it in the form of a univalent positive ion. This ion, however, tends to be held by a strong force to the tungsten surface because of the negative charge induced in the metallic surface by the close proximity of the positive charge of the ion.

The presence of such films is shown experimentally by the very high electron emission and by measurement of the contact potential with respect to a second tungsten filament held at such temperature that the cæsium has evaporated off.

In the presence of minute traces of certain electro-negative gases, adsorbed films of the atoms of these gases are formed on the tungsten, resulting in an increase in the electron affinity of the surface and a corresponding decrease in the normal electron emission (in absence of cæsium). But the tendency of the cæsium to be held by such a surface has thereby been increased, with the result that the cæsium film remains on the surface at an even higher filament temperature. The film then consists of two layers, each of atomic thickness, the first being of electro-negative, the second of *electro-positive atoms (ions)*.

In this way the cæsium film remains intact up to temperatures of about 900° K., and at this temperature (below a visible red heat) emits saturation currents of about 0.3 amperes per square cm. of filament surface. At higher temperatures the cæsium film evaporates off in part and the electron emission falls rapidly. On lowering the temperature the cæsium film reforms and the electron emission returns to its former value. At temperatures below those at which evaporation is appreciable, the saturation current from a cæsium-covered surface is expressed within the probable error of temperature measurement, by Dushman's equation,

$$i = 60.2\, T^2 \epsilon^{-b_0/T} \text{ amps. per cm.}^2$$

where b_0 = 16000 degrees. This corresponds to a value of 1.38 volts for the Richardson work function. It is of interest to note that b_0 appears to be practically the same whether the cæsium is adsorbed directly on tungsten or on the adsorbed electro-negative film. The electron emission thus depends primarily on the nature of the atoms forming the actual surface layer and is not materially dependent on the atoms that lie under these.

When a tungsten filament is heated above 1000° K. *in cæsium vapor at room temperature*, the electron emission falls to negligible values although a large fraction of the surface may still be covered with adsorbed cæsium. This is due to the fact that there is a linear relation between Θ, the fraction of the surface covered by cæsium, and the logarithm of the saturation current. At 800° K. the ratio between the emission from a cæsium film ($\Theta = 1$) and from a pure tungsten surface is about 10^{20}. Thus every change of 0.05 in the value of Θ causes a ten-fold change in the emission. By the time Θ has fallen to 0.7 the emission at 800° or 900° is negligible.

When the cæsium evaporates from the surface film at temperatures in the neighborhood of 1,000° K. it does so in the form of neutral atoms. Although the electron affinity of a pure tungsten surface is greater than that of the cæsium atom the electron affinity of a surface *partly covered by cæsium* may be less. This does not prevent the cæsium in the surface film being in the form of ions, for the electron affinity that is involved in the formation and stability of these ions in the surface is not that of the surface of the filament but rather that of the pure tungsten layer underlying the cæsium film. As the cæsium ions evaporate from a largely covered surface they take up electrons as soon as they get out of the surface film, for the filament surface, from the position they are then in, has less electron affinity than the ions.

The electron affinity of a surface partly covered with cæsium is a linear function of Θ as follows:

$$\varphi_{\Theta} = \varphi_w - \Theta(\varphi_w - \varphi_{cs})$$

where φ_w, φ_{cs}, are respectively the electron affinities of pure tungsten and a cæsium film, while φ_{Θ} is the electron affinity of the surface when Θ is the fraction of its surface covered by cæsium. Placing $\varphi_w = 4.52$ volts; $\varphi_{cs} = 1.38$ volts and making φ_{Θ} equal to the ionizing potential of cæsium (3.90 volts) we find $\Theta = 0.20$. Therefore when 20 per cent. of a tungsten surface is covered by cæsium atoms, the electron affinity of the surface is the same as that of cæsium ions.

Thus when the filament temperature is raised to a point such that Θ is in the neighborhood of 0.2, positive ions begin to escape from the filament without combining with electrons. This result, first found experimentally, occurs at a certain critical temperature in the neighborhood of 1150° K., depending to some extent on the pressure of cæsium vapor and the condition of the filament surface.

The surface of the filament is in one of two states which we may denote by α and β and the transition between these is discontinuous. At a given time part of the filament may be in one state while an adjacent part at the same temperature is in the other state, there being a sharp *boundary* between the two regions which boundary may be made to move along the filament at any desired velocity.

In the α state Θ is more than 0.2, the surface being largely covered by cæsium. The cæsium evaporates in the form of neutral atoms, although as the critical temperature is approached an increasing fraction may leave as positive ions.

In the β state Θ is ordinarily very much less than 0.2 and all cæsium which leaves the surface is in the form of *positive* ions. Since every atom that strikes the surface condenses, the rate of production of positive ions is equal to the rate at which cæsium atoms strike the filament. Thus from the kinetic theory we calculate that the saturation positive current i_+ is

$$i_+ = \frac{ep}{\sqrt{2\pi mkT}} = 0.367\frac{p}{\sqrt{T}}\text{amps./cm.}^2$$

where p is the pressure of cæsium vapor in bars, m is the mass of an atom of cæsium, e the charge of an electron, k the Boltzmann constant and T is the absolute temperature of the bulb. The rate of generation of positive ions is thus independent of the filament temperature provided this is above the critical temperature. It is also the same for all filament materials which give the effect. It is proposed that any electrode which *gen*erates positive ions be called a *genode*.

Experiments show that the maximum positive ion currents obtainable from a genode are in fact, above a certain temperature, independent of the genode temperature, are proportional to the vapor pressure in accordance with the above equation, and are the same for tungsten, molybdenum, carbon or nickel.

It is necessary to apply a certain negative voltage to the cylinder to draw off all the ions generated by the genode. Above this voltage the currents appear to be absolutely independent of voltage (much more so than in the case of electron emission). Below this voltage the positive ion current is limited by space charge, the current being proportional to the 3/2 power of the voltage but being smaller than in the case of electron currents between similar electrodes in the ratio of the square roots of the masses of the electron and the cæsium ion (1 : 490).

The measurement of the ion generation affords an apparently extremely accurate method of determining the vapor pressures of alkali metals. For example at a bulb temperature of 24° C. the maximum positive ion current in cæsium vapor is 32×10^{-6} amps./cm.^{2} from which the vapor pressure is calculated, by the equation given above, to be 0.00166 bar.

The conditions near the critical temperature, where both the α and β surface phases may be present together, are probably analogous to those assumed in van der Waals' theory of the transition between liquid and gas. In the β phase near the critical temperature there is probably an atmosphere, extending out to a distance of several Ångstrom units from the surface of the filament, containing electrons and a slight excess of positive ions. If the temperature is lowered the attractive forces cause a condensation to the α phase which has a much higher concentration of positive ions. At still lower temperatures, the ions probably settle down into a definite monatomic adsorbed film. Under proper conditions the velocity of propagation of the boundary between the two phases has been observed experimentally.

If a thoriated tungsten filament is used in experiments with cæsium vapor it is found that both the electron emission and the ion generation disappear if the filament is first given a heat treatment by which an adsorbed film of thorium is brought to the surface. This result is in full accord with the theory outlined above, for the electron affinity of a fully active thoriated filament is only 2.94 volts. Since this is less than the electron affinity of the cæsium ion we should not expect the cæsium atoms to lose their electrons when they strike the surface. A quantitative study is being made of the phenomena occurring when various proportions of the surface are covered by thorium.

Similar effects to those described in this paper have also been observed with other alkali metal vapors, notably rubidium vapor. The ionizing potentials of these vapors are higher and the vapor pressures lower, so that the effects tend to be less marked. The results, however, confirm the theories which so well explain the behavior of cæsium.

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THE OXIDATION OF SELENIUM BY A NEW GROUP OF AUTOTROPHIC MICROORGANISMS

The discovery of the nitrifying and sulfur-oxidizing bacteria by Winogradsky added much to our knowledge on energy transformation in the metabolism of the living cell. Here were organisms that were able to obtain from the oxidation of purely inorganic substances all the energy necessary for their activities and for the assimilation of the carbon from the carbon dioxide of the atmosphere or from carbonates. The hydrogen, methane and iron bacteria were soon added to these groups of autotrophic microorganisms. However, some of these organisms seem to be able to exist also in the presence of organic matter, from which they can derive their energy, as pointed out by Niklewsky for the methane bacteria, Molish for the iron bacteria and purple sulfur bacteria, Beijerinck and Trautwein for the denitrifying colorless, sulfur oxidizing organisms.

Among the strictly (obligate) autotrophic bacteria, which derive their energy only from the oxidation of the inorganic materials, are the nitrite and nitrate bacteria, as pointed out by Meyerhof, and the sulfur oxidizing organism *Thiobacillus thiooxidans* described recently by the writers, which derives its energy from the oxidation of elementary sulfur, thiosulfates and sulfides.

Another group of organisms can now be added to the list of the autotrophic forms, namely, bacteria which are able to derive their energy from the oxidation of selenium. A small quantity of selenium mixed with fresh soil was slowly oxidized with an increase in soil acidity. When some of this soil was added to a culture medium, consisting of inorganic materials, with elementary selenium as the only source of energy, the medium became cloudy within a few days. There appeared in it a minute, rod shaped bacterium capable of oxidizing selenium to selenic acid. A detailed description of the organism as well as of the methods used in its isolation will be published later.

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THE DRY-ROT OF OUR ACADEMIC BIOLOGY[1]

Our society requires its retiring president to close the annual meeting with a discourse or sermon—a task which has become increasingly difficult, for every year the program of the morning and afternoon sessions becomes more abstruse and therefore makes greater demands on our attention and the lingering memories of past presidential rhetoric invite to more odious comparisons. To me the task was the more arduous, because I had been busy for many years in remote fields of entomology in which few of you are interested, and because it fell to me at an inopportune moment, while I was in the very act of laying—if you will pardon a French expression—a volume of some 1,100 pages on ants. This racking oviposition leaves me reduced to a mere blob of corpora lutea and so feeble that I can only crawl, in search of a text for my sermon, to the next Encyclopedia Britannica article, which is not "ant-eater," but "Antæus." You will recall Antæus, that mythical F_1 generation hybrid between Poseidon, the Sea, and Gaia, the Earth. His hybrid vigor was so great, we are told, that he not only grew to gigantic stature, but insisted on wrestling with every stranger that happened to pass through his Libyan domain. He was always invincible in these encounters because his strength waxed with each successive contact with his mother Earth. When not engaged in wrestling he was building a monument to his father with the skulls of the vanquished. One day Hercules came along and, knowing the secret of the giant's strength, raised him aloft and strangled him in the air.

We may, perhaps, interpret this exploit of the sun-god Hercules as a mythical expression of the fact that no terrestrial substance can permanently resist evaporation or volatilization by heat, but the accepted and, I believe, more manifest meaning of the myth is that even an agile and vigorous mortal had best keep his feet on the concrete if he wishes to avoid death at the hands of the Hercules of abstraction. That the myth is of rather late origin would seem to be indicated both by this somewhat sophisticated interpretation and by the fact that the slaying of Antæus was not one of the twelve great labors of Hercules, but one of his Parerga, or deeds done by the way. The athletic demigod, while sprinting across the Sahara to get the golden apples of the Hesperides, merely stopped for a few minutes to finish Antæus. One might conjecture that the myth had been invented by some malicious Athenian potter or weaver, who, happening to live next door to the Academy, had often been annoyed by the "hot air" emanating from that institution, were it not that an Antæus-Hercules wrestling bout is known to have been a brilliant scene in one of the lost dramas of Phrynichus, written about 500 B. C.[2] Nevertheless, the myth remains to this day as one of the most beautiful expressions of the practical man's attitude toward those who place too much confidence in their more abstract intellectual operations.

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[1] Address of the president of the American Society of Naturalists, Boston, December 29, 1922.

After securing this text there was difficulty with the title of my sermon. I could not decide whether to call it the "tommy-rot" or the "dry-rot" of our academic biology. I finally chose the latter, because some of our activities so closely resemble the inroads of the fungus *Merulius lacrymans* in old timber, and because it might be amusing to find that the conscientious cataloguers of the Widener Library had included my effusion under cryptogamic botany or phytopathology. Imagine the hilarity of some young foot-ball player in the year of our Lord 1952, condemned to bone up for a final exam, and happening on a reprint of this paper reposing unashamed between such monuments of cryptogamic erudition as the 74 folio volumes of Professor Farlow's "Toadstools of God's Footstool" and the 27 quarto volumes of Professor Thaxter's "Laboulbeniales of the Universe"—like a naughty tick pressed between the hide of some royal Siamese she-elephant and that of her suckling daughter!

Text and title having been selected, autopsychoanalysis, which, like prayer, is now one of my favorite diversions, revealed the fact that I was suffering from an acute, repressed desire to commit sabotage on our academic biology by hurling a monkey-wrench into its smug machinery. Since, according to the Freudians, such desires simply must be satisfied, and since I may never have another opportunity to hit so many of the wheels with one shot, I can see no reason why I should not obtain all the catharsis to which psychopathology entitles me. My mental condition is, no doubt, partly due to the disappointing spectacle of our accomplishments as more or less decayed campus biologists in increasing the number, enthusiasm and enterprise of our young naturalists. I estimate that at least 25 per cent. of all students graduating from our colleges have had the equivalent of an elementary course in zoology or botany.[3] There must be many thousands of these young men and women in the country and yet, in a prosperous population of 110,000,000, the number with a vital and abiding interest in biological inquiry, even as an avocation, is extremely small. And in our universities, apart from the students preparing to enter medicine, the number indulging in advanced and graduate courses in the science would probably shrink to zero if we failed to provide fellowships or to hold out to them at the end of a long pole that enhaloed bundle of hay, the doctor's degree.

Is this situation due to the moronic ignorance or the satanic machinations of our trustees, presidents and deans? I take down Professor Cattell's illuminating monographs on the taxonomy and behavior of this fauna, but can not find that it is to blame. Is it the fault of the students? Obviously not, for no country produces a greater and more sweetly docile mass of pedagogical cannon-fodder. It would seem, therefore, that the teaching of biology should not be entrusted to those whom Bismarck called the damned professors, or that there is something wrong with us who try to teach the science, or with the environment in which we carry on the business. I can not avoid the impression that the problem involves, in varying degrees, all three of these factors. Of course, their adequate discussion would be extremely wearisome. I can only pull out little mycelial tufts of *Merulius lacrymans* here and there and submit them to your inspection as evidence of the dry-rot which seems steadily to be invading the underpinning of biology, at least in some of our eastern universities. If you can bear with me, after a day of strenuous attention to far worthier utterances, I shall first consider very briefly some of the disabilities, both material and personal, under which we seem to be laboring, and in conclusion suggest what I believe might be an ameliorative if not a remedial plan of action.

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[2] One may also conjecture that the story of Antæus is a very ancient but much distorted vegetation myth. It certainly resembles the myths of the Phrygian Lityerses and the Lydian Syleus. Both of these vegetation gods compelled strangers to compete with them, the one in the corn-field, the other in the vineyard, and both habitually slew their competitors and were in turn slain by the passing Hercules. See Frazer, "The Golden Bough," abridged ed., 1922, pp. 425, 442.

[3] *Cf.* the very temperate article by Professor H. H. Nininger, "Zoology and the College Curriculum," *Scient. Month.*, 16, 1923, pp. 66-72, an article which I did not see till after the delivery of my address.

The hampering effects of the material and environmental conditions under which we strive to inspire the young to become life-long naturalists deserve more attention than they have received. Any one of us who endeavors to grasp with his poor intellect, enfeebled by years of gyration in the academic mill, the stupendous and confusing accumulation of facts, not to mention the assumptions, fictions, hypotheses, theories and dogmas that make up present-day biology, must be staggered by the difficulty of selecting the most appetizing, concentrated and nourishing food for the student just entering the academic cafeteria. Perhaps no other collegiate department is expected to deal with such a vast and heterogeneous wealth of potential pedagogical pabulum. And the difficulty is greatly increased by the fact that one and all of us are highly specialized cooks, who delight in feeding the young on the dishes we ourselves like or that mother used to make and incidentally in showing our fellow cooks what delicious messes we can prepare. The student's metabolism may require plain gruel and toast, but we often insist on filling him up with so many elaborate pastries and salads that we ruin his digestion and, what is a thousand time worse, his appetite. Please bear in mind that I am trying to discuss the very practical business of teaching, not research. I am, of course, a ritualistic, high-church, port-and-sherry-loving Episcopalian in research, but only a poor, Peruna-soaked Methodist when it comes to teaching. I would go to such absurd lengths in helping research that I would even provide a room in the very modest institution to which I belong for any young man who might wish to spend the next ten years of his life investigating, say, the nucleololus of the fourth cell from the end of the last caudal cartilage of the embryo chipmunk, and if his work became very absorbing and his digestion impaired, I should be willing to feed him through a tube in the wall till his head swelled to the size of the room and he believed that he had become the nucleololus of Betelguese, but I should not permit him to see, much less converse, with freshmen. Such a pearl should not be cast before swine.

We might regard it as a great handicap that we academic biologists, unlike our native woodchucks and muskrats, are compelled to be most active pedagogically during the annual glacial period, but our superior intelligence enables us to cope with that situation. Every autumn we lay in a few cans of soused dog-fish and pickled sea-cucumbers, coop up some guinea-pigs, earth-worms, cockroaches and fruit-flies, throw in a bag of beans and several bales of hay for the botanists—and we are prepared for the worst. We can now proceed to disentangle and unreel the infinite and ineffable complexity of organic reality. We have more than enough for the purpose, for were we not all taught in our childhood by some old maid with ringlets that any little flower, or any little bug, for that matter, plucked from the crannied wall and held in the hand, is sufficient? When the neophyte becomes nauseated with the mess we have provided we can encourage him and incidentally heighten our own prestige by telling him that he is learning to forecast and control the behavior of organic nature, that he may shortly be able to make real live homunculi and regulate their mating habits, and all the pishpash with which, since the Neolithic Age, other priests and other wizards have heartened their constituencies.

More important than the drawbacks I have hinted at are certain types of personality engaged in the business of teaching biology. Since the inquiring scientist insists on poking his nose into every fold of reality, and since biology professors constitute a part, and, in their own estimation at least, an important part of reality, we might expect them not only joyfully to investigate the behavior of their colleagues—they do this already—but also to submit themselves to investigation, with at least a show of good grace. What startling results we might hope to obtain from a thoroughgoing application of the Freudian and Adlerian analyses and the intelligence tests! But even if we concede that the damned professor is an extraordinary being because he has sufficient inertia to specialize for a life-time in a particular department of learning, we must admit that he will grow old like the most ordinary individual of his species. He will gradually take on most or all of the stigmata of gerontic involution, which Dr. G. Stanley Hall has enumerated. At forty, if not sooner, his sense-organs, musculature, endocrines, emotions and memory will begin to atrophy and his intellectual processes will become more and more stereotyped, dogmatic and abstract. From a young Antæus continually gaining fresh strength from each successive contact with concrete reality he will become a creature increasingly infatuated with generalizations, relationships and hypothetical explanations, especially if they are of his own confection, and he will eventually drift into a stage in which words, formulæ and imaginary entities become the very breath of his nostrils. He has been borne aloft to be slowly asphyxiated in the tenuous atmosphere of the unreal. There are, of course, all degrees of the process and it is so gradual that it may completely escape even a professor. One rather mature student, who had spent four years in a divinity school, recently told me that, having outgrown theology, he had entered the course of one of our eminent geneticists, a man capable of twisting one's head off, were one to insinuate that he had ever released his feet from the concrete. A few weeks later the student quietly dropped the course and when asked the reason replied that the professor's mental processes were so similar to those of his decrepit divinity teachers when they held forth on predestination, salvation through grace, infant damnation, and the like, that he had decided not to add a fifth year to his theological training.

Unfortunately we have no intelligence tests for individuals with a mentality of more than 18 years, and biologists are supposed to be older, though some of them somehow manage to harmonize a physical age of 40 to 60 with a mentality of 8 to 14. These, however, if really human and endowed with a decorative personality, seem to make the best teachers, probably because they enter most readily into mental rapport with the freshmen and sophomores. It is not from such professors that the Merulius spores proliferate most profusely, but from those who have a physical age of 40 to 60 and a mental age of 80 to 105.

I do not wish to be misunderstood on this matter of aging. Those of us whom the gods have not sufficiently loved to remove early in life all develop what might be called the normal inferiority complex of senescence, but we rationalize and compensate or even overcompensate for it. This is apparent in all the discussions of the subject from the remarks of the aged Cephalus in the prologue of Plato's "Republic" and Cicero's "De Senectute" to the very recent essay of the still delightfully youthful Professor Jennings "On the Advantages of Growing Old." La Rochefoucauld put the matter concisely when he said that "old men are fond of giving good advice in order to console themselves for being no longer able to serve as bad examples." As youngsters we are all filled with a spirit of adventure and long to dominate reality; later, after we have worn down our eye-teeth on its resistant carapace, we try to compromise with it by cajolery, and when this, too, fails, we forsake it and create a reality of our own, a realm of ideas, Platonic, esoteric, inviolable, eternal, in which we can still exercise the meager remnants of our will to power. This type of senescent compensation is most beautifully displayed in the sheltered environment of our universities, and I would not underestimate its enormous value to science and therefore to the race. It is clearly exhibited by old or prematurely old taxonomists, morphologists and geneticists, who derive from static fictions like species, unit characters, genes, etc., a certain feeling of potency, of having their fingers on the very vitals of organic reality. Many of our most revered biological hypotheses are the work of senescents who have been sufficiently industrious and ingenious to make their subconscious compensatory strivings tally with very considerable bodies of facts. It would be interesting to ascertain the precise age, conditions of the sense-organs, endocrines, etc., of men like Darwin, Spencer, Galton, Weismann, Bruecke, Naegeli, Haeckel, Jaeger, Altmann, Wiesner, Haacke, Brooks, Verworn, DeVries, Hatschek and Johannsen, when they first began to operate with pangens, biophors and similar ultra-microscopic flora. We might also need the cephalic index, since certain racial tendencies may be involved. This is suggested by the fact that the French and Italian biologists have rarely shown the slightest interest in the construction of such entities. Are these biologists deficient in imagination or analytical power? Hardly. Or must we assume that the French and Italians, after having produced so many of the great scholastics, have lost confidence in their methods of dealing with the phenomenal world?

Undoubtedly the best culture medium for the academic dry-rot fungus consists of about equal parts of narrow, unsympathetic specialization and normal or precocious senile abstraction; and as this medium is always present in many personalities that find their optimum environment in our universities, the outlook is depressing. A friend who has long been studying our institutions of learning maintains that our only salvation lies in discharging all our faculties and burning or thoroughly disinfecting all the buildings every 25 years. I am somewhat less pessimistic, for although I have seen very little improvement in pedagogical method in our biological departments during the past 35 years, the stress they have laid on research has preserved them from the hopeless mummification that has overtaken some of the other departments.

It seems to me that there are two periods when the young biologist is most susceptible to lethal infection by the Merulius spores that are continually being thrown off by his professors. One is his freshman year, when he should be stimulated to develop an enthusiastic, receptive attitude, the other his graduate year or years, when he may be expected to adopt an independent, adventurous and creative attitude toward his science. Of course, the treatment of advanced students is easy for any professor who will follow the excellent example of the late Professor Roland of Johns Hopkins. The story is told that he was once presented with a list of rules for teaching graduate students and that he crossed out all the items and wrote beneath: "Neglect them!" Despite this very convenient precept, many of us coddle our graduate students till the more impressionable of them develop the most sodden types of the father-complex. Some of us even wear out a layer of cortical neurones annually, correcting their spelling and syntax. One fussy old guru of my acquaintance has destroyed both of his hemispheres, his corpus callosum and a large part of his basal ganglia hunting stray commas, semicolons, dashes, parentheses and other vermin in doctor's dissertations.

Not only do many of us wear out our most valuable tissues converting the graduate students into mere vehicles of our own interests, prepossessions and specialties but nearly all of us fail to excite in them that spirit of adventure which has in the past yielded such remarkable results in the development of our science. The finest example of this lack of vision is seen in the stolid indifference, especially in our eastern universities, to exploration and research in the remoter portions of our own country, in foreign lands and especially in the tropics. We have in the Philippines and at our very doors in the West Indies, Mexico, Central and South America the most marvelous faunas and floras in the world, but we still persuade our traveling fellows to cut more sections in the laboratories of Professor Rindskopf of Berlin or Professor Himmelschwanz of Leipzig, because thirty or forty years ago we were sent to the same *bemooste Häupter*. There was then a certain justification for this procedure because we at least picked up much valuable information from our fellow students in the *Bierstube*. But what shall we say to such dry-rot exhibitions as the following? A few years ago I was asked to secure a young botanist to accompany a biological expedition to the little-known Solomon Islands and therefore begged one of our eminent *exsiccati* to aid me in the quest. To my amazement he actually asked me whether I did not know that New England was covered with a luxuriant and almost unknown flora and did not regard it as a crime to dissuade a young botanist from devoting his life to pressing the plants of Cape Cod! And yet the theory which has revolutionized all our thinking was brought to us from the tropics by two naturalist explorers, and for a century those who have presided over higher education in Great Britain, France, Germany and the Scandinavian countries have seized every opportunity to send their young biologists to the tropics. I refrain from wearying you with the long list of gifted European naturalists who, just before the war and throughout the tropics of both hemispheres, were increasing our biological knowledge by leaps and bounds. The neglect of our splendid opportunities has, in fact, become such a scandal that it is known even to our august band of Delphic hierodules[4] in crinolines, the National Research Council.

When we leave the advanced student and turn to the beginner, the picture is even more depressing. To us serontic schoolmarms in trousers, who have flown from reality and have slowly succumbed to autistic thinking, with defective eye-sight, doughy musculature, brittle ossifications, demoralized intestines, decayed autonomic nervous systems and atrophied interstitials, there comes every year a small army of freshmen—very properly so called—in the late teens and early twenties, burning for impact with reality, with exquisite sense-organs, superb bones, muscles and alimentary tracts, mirific endocrine and autonomic apparatus and a mentality of nine to fourteen years, or thereabouts—and what do we give them? Perhaps we give them what they deserve for coming to us, but it might be more charitable to discuss what we do not give them. What portion of the science of life, that most concrete and most entrancing of all the sciences, ought we to administer to this suckling host of postadolescents? I answer: they should be fed during the first year on the simple oat-meal pap of ecology, but I hasten to declare that I do not mean the "ecology" of the zoologists, and especially of the botanists, of what Mencken calls the silo and saleratus belt of our great republic. For the sake of defining my meaning I shall have to make another tedious digression.

If, as some one has said, mathematics is the science that gives a single name to a great many different things, biology is certainly the science that gives a great many names to the same thing. This is an old story to the taxonomist, who, if he be worth his salt, will not only confer as many names as possible on every animal and plant, and change those of the commonest species every *six* months, in order to apprise other biologists that he is on the job, but he will also consign as many as possible of the other fellow's names—especially if he dislikes the other fellow—to the synonymy. I admire Haeckel, but I dislike his term "ecology" and have repeatedly pointed out that it belongs in the synonymy with a number of other terms, ranging in order of priority as follows: "natural history" (eighteenth and nineteenth centuries), "ethology" (Isidore Geoffroy St. Hilaire, 1859), "ecology" as "Relationsphysiologie" (Haeckel, 1866, 1869), "Biologie" in the restricted German sense (later nineteenth century to present), "bionomics" (E. Ray Lankester, 1889), "behavior," "comportement," "Gebaren" (past three decades). In this country the inept Haeckelian term, largely as a result of the afore-mentioned silo and saleratus botanists and their zoological camp-followers, has won the day and my adrenals are now too weak to offer further resistance.

Huxley, writing in 1879, apparently distinguished three ontogenetic and phylogenetic stages in the development of biology. He says: "Every country boy possesses more or less information respecting the plants and animals which come under his notice, in the stage of common knowledge; a good many persons have acquired more or less of that accurate, but necessarily incomplete and unmethodized knowledge, which is understood by Natural History; while a few have reached the purely scientific stage, and as Zoologists and Botanists, strive towards the perfection of Biology as a branch of Physical Science. Historically, common knowledge is represented by the allusions to animals and plants in ancient literature; while Natural History, more or less grading into Biology, meets us in the works of Aristotle, and his continuators in the Middle Ages, Rondeletius, Aldrovandus and their contemporaries and successors. But the conscious attempt to construct a complete science of Biology hardly dates further back than Treviranus and Lamarck, at the beginning of this century, while it has received its strongest impulse, in our own day, from Darwin."

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[4] The definition of "hierodule" in the Century Dictionary is followed by the remark: "Large numbers of such slaves were attached to some *foundations, and were either employed* about the sanctuary or let out for hire for the profit of the god."

This view of the matter is no longer adequate, quite apart from the fact that we are now entering on a fourth stage, a kind of metabiology, embracing biochemistry. The first of Huxley's stages, that of "common knowledge," should have been differently presented, in order to emphasize the practical, or economic source of the science in the activities and lore of the hunter, trapper, woodsman, herdsman, fisherman, husbandman, gardener, herbist, midwife, medicineman, etc. His second stage, that of "natural history," seems also to be presented in an adequate, if not misleading manner, probably because he was primarily a morphologist and somewhat dazzled by the fresh effulgence of the Darwinian theory of evolution, so that he seems to treat natural history not only as a transitional but also as a transitory phase in the development of biological science. History shows that throughout the centuries, from Aristotle and Pliny to the present day, natural history constitutes the perennial root-stock or stolon of biological science and that it retains this character because it satisfies some of our most fundamental and vital interests in organisms as living individuals more or less like ourselves. From time to time the stolon has produced special disciplines which have grown into great, flourishing complexes, and it has itself changed its name from time to time as the investigators of different periods have been impressed by different aspects of its fundamental tendencies. Aristotle wrote of the "histories" of animals, the naturalists of more recent centuries spoke of their "habits"; we have become more articulate and speak of their "behavior." Even a superficial acquaintance with the voluminous writings on natural history from those of the Stagirite to those of Gessner, Réaumur and Buffon and the naturalists of the first half of the nineteenth century, shows that for obvious psychological reasons human interest in organisms has always centered in their activities or what we now call their reactions to stimuli, their adjustment or adaptations to their environment and to one another. By the latter part of that pedantic century, the eighteenth, such great reserves of observation and experimentation had accumulated in the stolon that it began to bud. Taxonomy, morphology, paleontology, physiology began to shoot up, branch and differentiate, becoming independent specialties, developing their own methods, fictions and hypotheses. In the middle of the nineteenth century, after the great voyages of exploration, the bud chorology, or geographical distribution appeared, and about the same time I. G. St. Hilaire and Haeckel, wishing to emphasize the fundamental importance of adaptation, but mistaking the stolon for a bud, named it "ethology" or "ecology." More recently another dear little bud, genetics, has come off, so promising, so self-conscious, but, alas, so constricted at the base. And future centuries will no doubt witness a further gemmation of biological disciplines from the same old natural history stolon.

This is, of course, an extremely imperfect and summary sketch of the development of biological sciences, but it emphasizes the primitive, central and dynamic source of our interest in organisms. Obviously we can offer no criticism of those who prefer to call natural history or ecology "general" or "external physiology." Burdon Sanderson in 1894 presented the matter very concisely from this point of view in the following passage: "Now the first thing that strikes us in beginning to think about the activities of an organism is that they are naturally distinguishable into two kinds, according as we consider the action of the whole organism in its relation to the external world or to other organisms, or the action of the parts or organs in their relation to each other. The distinction to which we are thus led between the *internal* and *external* relations of plants and animals has of course always existed, but has only lately come into such prominence that it divides biologists more or less completely into two camps—on the one hand those who make it their aim to investigate the actions of the organism and its parts by the accepted methods of physics and chemistry, carrying this investigation as far as the conditions under which each process manifests itself will permit; on the other, those who interest themselves rather in considering the place which each organism occupies, and the part which it plays in the economy of nature. It is apparent that the two lines of inquiry, although they equally relate to what the organism *does,* rather than to what it *is,* and therefore both have equal right to be included in the one great science of life, or biology, yet lead in directions which are scarcely even parallel. So marked, indeed, is the distinction, that Professor Haeckel some twenty years ago proposed to separate the study of organisms with reference to their place in nature under the designation of 'œcology,' defining it as comprising the relation of the animal to its organic as well as to its inorganic environment, particularly its friendly or hostile relations to those animals or plants with which it comes into direct contact. Whether with the œcologist we regard the organism in relation to the world, or with the physiologist as a wonderful complex of vital energies, the two branches have this in common, that both fix their attention, not on stuffed animals, butterflies in cases, or even microscopical sections of the animal or plant body—all of which relate to the framework of life—but on life itself."

The stolonic relationship of natural history, or ecology to the other biological disciplines is of great theoretical and practical significance. Nearly all the important biological problems, especially of a physiological or morphological character, have arisen in the course of simple investigation in natural history and many of the more difficult of them have been turned over to the special disciplines for solution. On the other hand, the ecologist is continually drawing on the methods and resources of physiology, morphology, taxonomy, distribution, etc., in solving his own particular problems of adaptation and behavior. The most interesting and important of them relate, not to the reactions of organisms to their inorganic environment, but to their reactions to one another. As this matter, though very simple, is often misunderstood, you will pardon me for dwelling on it for a few moments. Since all organisms, either of the same or of different species, invariably live in relationships of dependence on or of cooperation with others, the ecologist is justified in regarding the whole living world as an intricate congeries of biocoenoses, or consociations, ranging in complexity from at least two to a great many organisms. Even genetics may be regarded as a department of ecology, which is striving to formulate the precise symbiotic relationships of the gametes to each other in the constitution of the zygote, and their reactions with the environment. Hence the problem of adaptation is not foreign to this discipline though it is at present either ignored, as Bateson implies, or expressed in terms that are unfamiliar to the ecologist and physiologist. Moreover, since human societies are very intimate and elaborate biocoenoses of individuals of the same species, psychology, sociology, economics, anthropology, ethnology, history, ethics, jurisprudence, government, hygiene, medicine, etc., are essentially ecological, for their central problems are behavioristic.

It follows from these considerations also that applied, or economic biology is merely applied ecology, as Forbes, Needham and others have repeatedly stated.[5] Whenever and wherever one of the organisms of a biocoenose happens to be man, we have an economic situation, and it is in the precise determination of the relationships thus developed that ecology celebrates many of its greatest triumphs. I need only refer to the great field of parasitology—the work on cestodes, trematodes, trichinæ, hookworm, malaria, yellow fever and all the other insect-borne pathogenic organisms, in bacteriology, phytopathology, economic entomology, etc., all work which does not transcend the concrete natural history or ecological level. And everything indicates that we are only at the beginning of the revelations and benefits which similar studies have in store for us. Surely the ecologist need not veil his face in modesty even in the presence of a Mendelian formula or a new Drosophila mutation.

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[5] *Cf.* the following passage by Professor J. G. Needham, *Science,* N. S., 49, 1919, p. 457: "Dr. Howard suggests that we give more time to taxonomy and ecology and less to physiology and genetics. This is a good suggestion. We are all out of balance. Some of our laboratories resemble up-to-date shops for quantity production of fabricated genetic hypotheses. Some of our publications make a prodigious effort to translate everything biological into terms of physiology and mechanism—an effort as labored as it is unnecessary and unprofitable. Why not let the facts speak for themselves? Our laboratories are full of fashions. They go from one extreme to another. In my high school days we learned systems of classification; in my college days we did nothing but dissecting; later came morphology and embryology, then experimental zoology, then genetics, and the devotees of each new subject have looked back upon the old with something like that disdain with which a debutante regards a last year's gown. Natural history and classification are perhaps long enough out of date, so that interest in them may again be revived. I hope so; for these are the phases of biology by means of which a youth is best oriented for more special work. Then, too, they are immensely practical.

Although I have left our lusty young freshmen out in the cold during this long harangue, I have not forgotten them. I repeat: what ought we to give them? I do not believe that we should inform them with the first crack out of the box that they are animals and descended from ape-like ancestors. This must come as a severe shock to any young *Boobus americanus* who has never had an opportunity to make the acquaintance of really high-class apes, like the chimpanzees recently studied by Wolfgang Koehler at the German Anthropoid Station on the Island of Teneriffe. The freshman should be gradually led through a sympathetic study of the lower organisms as marvelous centers of beautiful and dignified processes to a knowledge of his own animal respectability, descent and responsibilities. This, I am convinced, is not to be achieved by taking dead and more or less smelly crayfish, earthworms, starfish and cockroaches to pieces, because Huxley in 1879 intimated that it might be a meritorious occupation for the young, nor by a too immediate study of living forms so remote in the scale of being as the Protozoa, Coelenterates and plants. It would seem to be preferable to start with living animals somewhere in the middle or higher reaches of organic development—small vertebrates, mollusks, insects, arachnids—and to make them the objects of direct, simple, comprehensive observation and experiment, severely suppressing or subordinating all morphological details which have no immediate bearing on the study of their activities. Necropsies, autopsies and postmortems might be introduced with discretion, but only after the student has acquired an acquaintance with the life-histories and more obvious methods of growth of his organisms—with the aid of moving pictures, whenever necessary—their methods of locomotion, feeding, respiration, excretion, defense and concealment, their reactions to light, temperature, humidity, etc., and especially to one another, *i. e.*, their mating, oviposition, parturition, nidification, parental care, predatory, parasitic, symbiotic, gregarious and social behavior, etc. Simple experiments in genetics, regeneration of lost parts, etc., could be introduced, but without cytological lace and ruffles. The successful teacher of elementary mathematics does not overwhelm and confuse the student with all the known recondite properties of the triangle and circle. The freshman laboratory should be neither an animal morgue nor a herbarium, but a vivarium. Its teaching staff should be numerous, competent, enthusiastic and young and, in order that Merulius infection may be avoided, no old professor or weary research student should be permitted to enter it without a complete change of mental underwear and, I might add, without a few moments of silent prayer or meditation at the door. To the present depauperate glacial fauna of the laboratory, the perpetual rat-guinea-pig-frog-Drosophila *repertoire,* we should add many of the thousands of even more interesting organisms that will live and multiply in confinement, and—although I realize the great difficulties involved—some means must be devised for taking the students into the field more frequently, since it is impossible to reproduce and study the more complex biocoenoses under artificial conditions.

You will probably agree that such a program of freshman work as I have very hastily sketched could in adroit hands yield at least a vital part of the needed preparation, first, for men who will devote the remainder of their collegiate and postcollegiate lives to occupations foreign to biology, and such men, of course, constitute the majority of any freshman class; second, for men who are primarily interested in the "Geisteswissenschaften"—psy-

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One has to deal with species, and must be able to recognize them; and all economic procedure is applied ecology.''

chology, philosophy, history, economics, law, etc.; third, for men who will enter medicine and may therefore be expected to specialize mainly in morphology and physiology during the remainder of their college course; fourth, for men who may wish to specialize in other departments of applied biology, such as agriculture, forestry, economic zoology and botany, fish and game conservation, etc., subjects to which our present freshman biology is a hopelessly inadequate introduction; fifth, for the biological investigator and teacher, who can not be too quickly persuaded to assume the modern dynamic and experimental attitude toward his science. It is, of course, this new attitude, that many of us older men, trained during the late Victorian morphological boom, have difficulty in assuming, and that makes us so conscious of our inability to participate very effectively in the biological education of the present generation.

There is another suggestion I should like to make, in order that the freshman course may be preserved from the dry-rot, which may invade even the most dynamic type of instruction, and that is the utilization by the instructor of competent amateur naturalists as occasional assistants. This seems never to have been tried, except in some of our summer camps and marine laboratories, and the reason is obvious. The typical professor has about the same liking for the amateur that the devil has for holy water, and the amateur habitually thinks of the professor in terms which I should not care to repeat. You will find a choice collection of them in Mencken's writings. The truth is that the amateur naturalist radiates interest and enthusiasm as easily and copiously as the professor radiates dry-rot. For years I have taken a malicious delight in introducing amateurs to professors, because the behavior of the latter on such occasions yields a precise quantitative test of the amount of Merulius in their timber. Dear, old, mellow, disinfected professors of the type of Louis Agassiz, Asa Gray, Shaler, Hyatt and Ryder enter at once into sympathetic rapport with the humblest amateur, but the young or those of middle age are almost invariably more or less priggish, condescending or worse. Now there is an opportunity to develop a mutual understanding and respect in both of these parties, so essential to the development of biological science, if the young instructors will only welcome and encourage the cooperation of the amateur in interesting his freshmen. We have all known amateurs who could make an enthusiastic naturalist out of an indifferent lad in the course of an afternoon's ramble and, alas, professors who could destroy a dozen budding naturalists in the course of an hour's lecture. The instructor who would from time to time call in some of our talented ornithologists, herpetologists, entomologists, arachnologists and malacologists to assist him, both in the laboratory and the field, would himself profit greatly, the significant human contacts of the students would be multiplied and the amateur be given just the right environment in which to spread the divine fire of his enthusiasm.

And this brings me in conclusion to what is perhaps the main source of our failure in incubating naturalists, and that is our too highly specialized, or esoteric attitude toward organic nature. Whether we contemplate the whole or only some particular portion of the realm of living things, it eventually tends to become for us merely so much material to be used in the solution of the many tantalizing problems which it suggests. We are, indeed, obsessed by problems. No doubt this is the correct attitude for the seasoned investigator, and no doubt a certain spirit of skeptical inquiry should be cultivated even in freshmen, but surely we should realize, like the amateur, that the organic world is also an inexhaustible source of spiritual and esthetic delight. And especially in the college we are unfaithful to our trust, if we allow biology to become a colorless, aridly scientific discipline, devoid of living contact with the humanities. Our intellects will never be equal to exhausting biological reality. Why animals and plants are as they are, we shall never know, of how they have come to be what they are, our knowledge will always be extremely fragmentary, because we are dealing only with the recent phases of an immense and complicated history, most of the records of which are lost beyond all chance of recovery, but that organisms are as they are, that apart from the members of our own species, they are our only companions in an infinite and unsympathetic waste of electrons, planets, nebulæ and suns, is a perennial joy and consolation. We should all be happier if we were less completely obsessed by problems and somewhat more accessible to the esthetic and emotional appeal of our materials, and it is doubtful whether, in the end, the growth of biological science would be appreciably retarded. It quite saddens me to think that when I cross the Styx, I may find myself among so many professional biologists, condemned to keep on trying to solve problems, and that Pluto, or whoever is in charge down there now, may condemn me to sit forever trying to identify specimens from my own specific and generic diagnoses, while the amateur entomologists, who have not been damned professors, are permitted to roam at will among the fragrant asphodels of the Elysian meadows, netting gorgeous, ghostly butterflies until the end of time.

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TENDENCIES IN AGRICULTURAL RESEARCH[1]

LAND rather than soil problems engaged the attention of our pioneer farmers. To them the passing of the public domain into private ownership meant much. It meant the conquest of the wilderness, the leveling of dense forest growth, the turning of prairie sods. It was the era of agricultural exploitation without the thought of climbing yields and of better races of plants and animals. The rugged faith and courage of the pioneer were pitted against a not over-friendly environment in the persistent building of an agricultural empire. But, while in the retrospect of the present day the outcome was predestined, the path of progress was beset with many difficulties and uncertainties. Despite these, an unending procession of home-seekers braved the perils and solitude of forest and plain, the human stream flowing on to the west to build, to sow and to harvest.

Scarcely more than one hundred million acres of our land surface had been transformed into improved land by the middle of the last century. In the following decade each year brought an addition of five million acres of improved land, a rate of progress temporarily halted by the tragedy of the Civil War. But the beckoning furrows lengthened and multiplied, and it was a poor year between 1870 and 1890 when the addition to our improved land area was less than ten million acres. In the thirty years following 1890 this area grew from about 360 to more than 500 million acres. The conquest is still to be completed, but the era of land exploitation as such has been well passed. Coincident with the development of our land resources the acreage of our staple crops grew by leaps and bounds. The area under hay and forage crops increased from about thirty millions in 1879 to about ninety-six millions in 1919. There was a corresponding increase from about sixty-two million to eighty-seven million acres in the case of corn, from thirty-five to seventy-three millions in the case of wheat, from sixteen to about thirty-eight millions in the case of oats and from fourteen to nearly thirty-four millions of acres in the case of cotton. The relative increase in the acreage of rye, potatoes, tobacco and rice was even greater. Increasing numbers of farm animals followed the expansion in the acreage of improved land. They brought, as did the expanding acreage, a great array of problems that insistently called for solution.

The pioneer farmer was chiefly interested in methods that promised the most effective utilization of the vast resources of our soils and forests. He reached out for more efficient tools as well as for more efficient plants and animals. The invention of agricultural machinery was stimulated by the apparently unlimited acreage and ready accessibility of agricultural land. Implements of tillage, as well as harvesting machinery, multiplied the labor resources of our farms. Improved transportation came with the reaching out of our railroad systems. Mechanical power was later added to our agricultural labor resources and land utilization soon assumed vast proportions. In response to the demand for more efficient plants and animals better varieties of plants were made available by importation and selection. Improved types of animals were likewise brought in from foreign countries and an effort was made to adjust both plants and animals to their new environment. Variety tests among the more important crops, exhibits at local and state fairs, the organization of breed associations and feeding trials constituted the means of hastening the introduction and use of the more productive types of plants and animals. But the era of exploitation had to reckon with the very serious losses caused by insect enemies, plant and animal diseases, animal parasites and predatory and destructive animals. To the problem of large scale production there was added the problem of adequate protection against these enemies. The Hessian fly, the chinch bug, grasshopper, weevils of stored grain, the codling moth, plant lice and wire worms are but a few of the outstanding insect pests that menaced the prosperity of the pioneer farmer. Farm animals were similarly threatened by ticks, flies, lice, mites and intestinal parasites. Fungi and bacteria levied a heavy toll on both crops and animals. Rusts, blights, mildews and other diseases became quite destructive even though the extent of the losses caused by them were not always fully appreciated. Cattle fevers and plagues, the spread of bovine tuberculosis, the ravages of hog cholera and the far-reaching damage done by blood parasites constituted a tax that early farmers seemed unable to escape. Quarantine, crop rotations and preventive treatment brought at best only partial relief. They helped to bring out in bolder relief the need for the accurate study of the mysterious forces that cast their evil shadow on the farmer's industry and thrift. To the progressive farmer there came the growing conviction that the solution of many of his problems lay outside of himself. He came to feel in time that the organization of schools of agriculture would react favorably on the interests of American farming and would point the way to better methods of production. The organization of experiment stations was a logical outgrowth of our agricultural colleges. The Land Grant Act, signed in the dark days of the Civil War, created the state agricultural colleges, which prepared the way and trained the men who later formed the vanguard of our agricultural research.

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[1] Address of the vice-president and chairman of Section O—Agriculture, American Association for the Advancement of Science, Boston, December, 1922.

Land utilization and the introduction of improved types of plants and animals were the outstanding features of American farming during the second half of the nineteenth century. During that time distinct progress was made in answering the more insistent questions of our agricultural industry. Feeding trials, variety tests, the analytical study of the soils and crops, rotation experiments and the study of the response obtained from applications of manure, fertilizer and lime became more and more common. The more exhaustive and discriminating study of the underlying principles had scarcely made itself felt. Through the general progress of science, the increased number of trained men and the more intelligent and generous public support, the opportunity became ripe for the more systematic organization of agricultural research. The new century thus brought with it the men and the resources for the comprehensive inquiry into other important phases of plant and animal production. Not content with the testing of empirical remedies, the entomologist attempted to gain an intimate understanding of the life history of insects, their response to changes in their environmental conditions, the nature and occurrence of insect parasites. The entomologist sought the aid of the chemist, the bacteriologist, the mycologist and the physicist. We learned to know about contact and stomach poisons and the reaction of insects to light, heat, humidity and the nature and supply of their food. The body of knowledge concerning insects assumed large proportions and was gradually organized to form the foundation on which systematic methods of eradication and control could be developed. Thus, sprays, dusts and fumigants, as well as parasitic insects and fungi, have helped to erect a more or less effective barrier against a menace that is never absent. In their efforts to minimize the damage done by microorganisms the bacteriologist, the botanist and the chemist found cooperation desirable and satisfactory. The development of resistant species of plants through selection and breeding offers more than a partial solution of a difficult problem. Similarly, resistance and immunity against pathogenic organisms has been the outcome of the isolation and study of microorganisms, their food requirements, the changes produced by them in the culture medium and the relation to their host. Sera, vaccines, antitoxins and bacterins were added to the weapons of defense against the invisible destroyers. In a word, then, the pioneer stage in the development of American agriculture had sufficiently tested the resources of agricultural research to prove its effectiveness and its promise. The mining of plant food was still carried on extravagantly and on a vast scale, the herds and flocks still grew in numbers, land utilization and crop and animal production had found at least partial insurance against catastrophic losses.

The more constructive phase of our farming belongs distinctly to the present century. Soil exploitation is finding its counterpart in soil building. The continuous growing of a single crop has largely been abandoned through force of necessity. Wheat, corn, cotton, flax, tobacco and other crops refused to yield a profit when grown on the same land year after year. Diversification and crop rotations established themselves through the farmer's efforts to escape the ravages of economic insects and fungus diseases. They found justification, also, in that they permitted the more economic use of labor and equipment resources of the farmer. But the theory of crop rotations, the significance of plant associations, the relation of individual crops to the soil micro flora and the plant physiological reactions of individual crops were to be made the subject of study at a later date. To the earlier farmers the use of lime was well known. The nature of the changes produced by lime, its relation to soil texture and structure, its effect on soil microorganisms and its direct and indirect influence on the plants themselves were to offer an attractive problem to the soil investigator. The practice of green manuring had become well established in the second half of the nineteenth century. The significance of the biological fixation of atmospheric nitrogen and likewise the biological formation of ammonia and nitrates was pointed out in the last quarter of that century. There were, nevertheless, many questions related to the underlying principles and their application that were still to be answered. Thus, the occurrence and distribution of symbiotic and nonsymbiotic nitrogen-fixing bacteria, the effect of soil reaction, the influence of the soil solution and of other factors on their activities were still to be determined. The more effective and the more profitable use of green manures was made possible by the more exact information on the response of the green manure plants to their environment. The botanist, bacteriologist and chemist have all had a share in creating this more exact information. In the building of soil fertility artificial fertilizers have played an outstanding rôle. Agricultural research has been obliged to deal with almost innumerable questions that have arisen in the manufacture and use of such fertilizers. The influence of fertilizers on the nature and concentration of the soil solution, the absorption and adsorption of soluble salts in different soils, the exchange of bases, the losses of soluble salts, the influence of the soil solution on germination and plant growth, the relation of fertilizer treatment to the activities of soil microorganisms and many other problems have received the attention of the investigator. Soil research is thus engaged in a thoroughgoing examination of the constructive phases of soil utilization. This is distinctive of the present trend of agricultural research. In so far as it may be consistent with economic practice, the tendency will become more manifest toward the liberal use of commercial fertilizers, the accumulation of reserves of available plant food in the soil and the effective utilization of the circulating plant food capital in increasing the average yield per acre. The soil investigator is very far from content with the results already achieved. He is reaching out toward a better understanding of the functions of manganese, fluorine, iodine and silica (formerly regarded as purely accidental constituents of plants). He is trying to find out to what extent protozoa are a limiting factor in the transformation of plant food by bacteria. Soil fungi and nematodes are, likewise, being made the subject of study in an endeavor to interpret more clearly the outstanding facts of soil biology. All this must hasten the progress toward higher levels of production just as selection, breeding and protection among plants and animals must assure us of the more effective utilization of our plant food resources. But there are other problems now coming to the fore in American agriculture that are offering themselves as a subject of fruitful research. We have come to agree that we must make better use of our food resources. Physiological research has pointed out to us that the blending of proteins and their derivatives, of carbohydrates, fats, minerals and accessory substances in the feeding of animals holds the promise of greater net profits to the livestock producer. The application rests on a body of knowledge slowly created and as yet not fully interpreted. We know something at least about the cleavage products of protein and of the analytical and synthetic processes occurring in the animal body. We have made more than a mere beginning in the study of internal secretions and their rôle in animal metabolism. The study of vitamines may have assumed unseemly proportions, but has none the less given us a rich fund of information. Animal nutrition has thus entered a new stage that points the way to the conservation of our food resources and their more effective use. Our knowledge of feeding stuffs appearing as industrial by-products has also become more exact. The protein and carbohydrate feeds represented by cottonseed, linseed and soybean meals, or peanut and copra cake, have certain limitations when their composition is considered. Other by-products, like bran, gluten feeds, dried beet pulp and molasses, are not always utilized to the best advantage. Research problems relating to both conservation and use are making a strong appeal to the investigator. The same may be said of the conservation and best use of hay, straw, cornstalks, sunflowers and other crop materials. The study of ensilage and the conditions under which it is produced has already yielded profitable returns. The investigator is now looking ahead to the more systematic study of our forage plants in order that a basis may be created for the more effective utilization of our pastures, ranges and forests.

Agricultural research is now concerning itself with the problems involved in the manufacture of what we might well term secondary agricultural products. These would include milk and its products, fruits, vegetables and their derivatives, meat products, starches, sugars, etc. We have traveled far along the road in our study of dairy products. We know much about bacteria and fungi more or less prominent in the manufacture of butter, cheese and fermented milk beverages. We have done almost as much in the study of fruit derivatives, such as marmalades, sugared fruits, dried fruits, etc., but many attractive problems are still before the investigator. This will apply also to vegetables and the other commodities already mentioned. The agricultural colleges and experiment stations, so generously supported by the tax-paying public, will be expected to lay more stress on the investigations of such manufacturing methods as would substantially reduce the terrific waste of food materials now constantly occurring in our fields, orchards and storehouses. For example, many millions of bushels of potatoes, sweet potatoes, apples, pears and peaches are allowed to decay because of the lack of facilities for their conservation. Much sugar and starch in inferior potatoes, fruit and berries should not be sent to glutted markets to compete with these ingredients in vegetables and fruits of better quality. As time goes on greater stress will be laid on the utilization of the sun energy stored in the cellulose of our corn stalks, straws and other now relatively worthless materials. Whether or not alcohol is the most promising successor to petroleum and its derivatives as a fuel for our motor-driven machinery, it is almost obvious that agricultural research will have to deal earnestly with the transformation of the now less valuable agricultural commodities into products possessing food, fuel or other value.

Agricultural research will reckon to an increasing extent with problems of storage and handling. Refrigeration has undoubtedly stretched our food resources, but there is need for research not only as to types and methods of refrigeration, but also on the effect of refrigeration on the market and food value of fruits, vegetables, meats and other commodities. Transportation offers certain research problems, for much of the food shipped by rail or truck is more or less extensively infected with bacteria and spores of fungi. Very extensive losses occur in transportation because of faulty cooling or handling. Our agricultural colleges and experiment stations will be expected to turn their attention to these problems. The quality and quantity of food as affected by storage, handling, transportation and distribution will then be less adversely influenced. Another tendency quite manifest in agricultural research is that relating to the economic side of agriculture.

The producer of agricultural commodities is just beginning to recognize the intimate relation that exists between his farm operations and the trend and interplay of economic forces. It is dawning upon him that production costs, taxation, land tenure, imports and exports, transportation, cooperation and marketing are vital factors in the agricultural industry. As he thinks of these a host of questions arise before him and fill his mind with doubt and suspicion. It is but natural for him under such circumstances to turn to his agricultural college and experiment station and to ask for light and guidance. He is readily given the information that is available, but he is made to realize, at the same time, that our knowledge of agricultural economics is, at best, quite limited. It is a field for exploration and ready to yield some of its secrets to the student and investigator. Because of his close contact with his agricultural institutions, he feels that he has a right to ask for research that would remove his perplexities, free him from the burden of uncertainty and allow him and his fellow farmers to build hopefully on the solid foundation of exact knowledge. Obviously, then, research on agricultural economics is to occupy the attention of our agricultural colleges and experiment stations. Research projects in this field will multiply. A demand will be made on the agricultural colleges to train men for the carrying on of research in this field.

The higher standards of living adopted by the progressive element in our agricultural population are creating a demand for research in the fields of sanitation and hygiene. The water supply in rural districts, its chemical and microbiological qualities, its possible significance as a carrier of pathogenic organisms, and its treatment and purification may be made the subjects of experimental study. The construction of septic tanks and of filter beds in connection with the disposal of household wastes, the mineralization of organic matter in sewage and the biology of sewage disposal on the farm present certain research problems. Flies and mosquitoes are not only a source of discomfort, but are potentially dangerous as carriers of disease organisms. Their control and possible elimination offers an opportunity for experiment and at times for the fundamental study of the relation of organisms to their environment.

The present day organization of the American farm creates well-defined problems in engineering. Farm power, the relative cost and effectiveness of animal and mechanical power, the relation of tillage machinery to soil texture and structure, the illumination and heating of dwellings and outbuildings, ventilation drainage, land clearing and road construction demand inquiry that may range all the way from simple tests to carefully planned research. The requests for these and other inquiries are becoming more and more insistent, and while our rural constituency is often more than generous in its support of agricultural research it is now and then impatient of results. When a new insect enemy or plant disease brings widespread destruction and loss the discouragement among the producers reacts unfavorably on the agricultural colleges and experiment stations, as well as on the Federal Department of Agriculture. The farmer facing ruin, like the cotton grower in the boll weevil infested territory, must have immediate relief and he expects nothing short of the impossible. But on the whole the farmers are loyal to the research institutions. Time is bringing to them a keener discrimination and the understanding that knowledge can be gained only slowly and painfully by following devious and thorny paths, by discarding much and keeping little. They are more appreciative of the time element in the conduct of important investigations and are willing to tax themselves and to contribute directly from their slender purses toward the time-consuming and rigid culling of facts and principles. There is much encouragement for the student of agricultural science in the broadening outlook of the nation, in its concern for the conservation and upbuilding of our land and crop resources. Well beyond the pioneering stage of exploitation and of empirical practice, we are moving forward to rising levels of production, and with the help of the trained man we are trying to look beneath the surface. We are reaching out into new fields of research endeavor, we are gathering facts and deductions from the outlying regions of science, we are multiplying and sharpening the tools of research workers, and are constantly widening the perspective of agriculture. Much is being given to agricultural research and much is expected from it. Will the Department of Agriculture and our colleges and experiment stations measure up to the task? The answer must be an affirmative one if we are to gauge future achievement by the more ample facilities for study at our colleges and universities and the zeal, the integrity and the humility of our research workers.

J. G. Lipman

Rutgers College

FRITZ WILHELM WOLL

Dr. Fritz Wilhelm Woll, professor of animal nutrition in the University of California, well known as a writer on animal feeding and dairy subjects, died at Berkeley on December 6.

Dr. Woll received his early education in Christiania, Norway, obtaining the degree of Ph.B. from the Royal Fredericks University, Christiania, 1883. Later, degrees of M.S. and Ph.D. were conferred by the University of Wisconsin in 1886 and 1904, respectively. After graduation as Master of Science at Wisconsin Dr. Woll was appointed second assistant chemist, Wisconsin Agricultural Experiment Station, 1887, and rose to the position of chemist for the station in 1897. He became professor of agricultural chemistry, University of Wisconsin, in 1906, which position he held until 1913, when he was called to the University of California as professor of animal nutrition, holding that chair until his death.

He was the author of many works, each of which has been reissued in a number of editions; among these may be mentioned:

"A Book on Silage," revised edition, 1900.

"A Translation of Modern Dairy Practice" (from Swedish of G. Grotenfelt), 1894, third edition 1905.

"A Handbook for Farmers and Dairymen," 1897, sixth edition, 1914.

"Testing Milk and Its Products" (with Professor E. H. Farrington), 1897, twenty-fourth edition, 1918.

"Productive Feeding of Farm Animals," 1915, second edition, 1916, third edition, 1921.

"Feed Manual and Note Book," 1917.

Dr. Woll accomplished a large amount of scientific work while at the universities of California and Wisconsin, as is well shown by the series of important and timely bulletins of the respective agricultural experiment stations. He was also an extensive contributor to technical publications and agricultural and dairy papers. His articles were always replete with valuable aid to dairymen and feeders in general.

It is primarily due to the untiring efforts of Dr. Woll that the cow-testing associations of so much value and importance to the dairy industry of California have been developed and placed on a business-like and permanent basis.

He was a member of many agricultural and scientific societies, including: Wisconsin Academy of Sciences, Arts and Letters; Society for the Promotion of Agricultural Science; American Society for Animal Production; Association of Official Agricultural Chemists, (president, 1909-11); American Dairy Science Association; Sigma Xi; Member International Jury Panama Pacific International Exposition, 1915.

The passing of Dr. Woll is a great loss to the University of California and to the animal industry of the whole country.

SCIENTIFIC EVENTS

INTERNATIONAL TELEPHONY

The inaugural address delivered by Mr. Frank Gill, as president of the British Institution of Electrical Engineers, as reported in the London *Times*, discussed the problem of establishing efficient international telephonic communication among the different countries of Europe, including Great Britain.

He expressed the opinion that, given adequate facilities, there is traffic waiting to be handled between the cities of Europe, and urged that there are weighty reasons for providing those facilities, such as the present necessity for improving the relations between nations, in addition to the normal commercial advantages. So far as distance is concerned, there is no engineering difficulty in constructing and operating lines at commercial rates to give satisfactory speech between any one and any other part of Europe; and he illustrated this statement by pointing out that between Brussels and Athens, or Paris and Constantinople, the distance is about the same as between New York and Omaha, between which calls can be made at any time, and that the direct distance overland from London to Delhi is about the same as from Key West in Florida and thence to San Francisco and Los Angeles, over which distance calls can be made regularly.

Results of this kind, however, require the use of elaborate technical devices, such as loading coils and repeaters. Formerly a long-distance telephone line consisted merely of a pair of copper wires, which with comparative ease could be kept in good order by independent maintenance units situated along its length. But now that simple structure has vanished, the plant is more complicated, the various parts are interdependent, and it is no longer possible to consider maintenance of each part solely as a sectional matter, since what is done at one place may cause serious effects at another.

Present knowledge can secure great increase in the distances spoken over, in the number of channels of communication afforded by one pair of wires, and in the cheapness, security and speed of the service, but a price must be paid for these advantages in the shape of definite and unified planning throughout the area to be covered, with unity of maintenance and of operation. In Europe, however, there are about forty self-contained local telephone operating organizations, which, though for through service they must function as a whole, are without coordination, standard practice or common technique of construction, maintenance and operation; and the through service is meager in quantity, slow and inefficient.

The through business must be handled as a complete unit, if it is to be efficiently done, and to Mr. Gill the correct course appeared obvious—to depute a body to do for all the European nations what no one nation can do for itself. Such a body, he suggested, might consist of a single company working under licenses from the various governments, or of a company or commission in which they would be the sole stockholders, which would operate all the through business both within and between the various countries of Europe. As another alternative, frankly of a temporizing nature, he suggested that all the telephone authorities should form an association and hold an early conference to study the problem in detail.

THE INTERNATIONAL COMMITTEE ON MARINE FISHERIES INVESTIGATION

THE International Committee on Marine Fisheries Investigations held its fourth meeting in Washington recently, the members present being William A. Found and Dr. A. G. Huntsman, representing Canada, and Drs. H. F. Moore, R. E. Coker and H. B. Bigelow, representing the United States. Dr. J. Playfair McMurrich, of the Canadian delegation, and Dr. James Davies, the Newfoundland delegate, were unable to attend.

The *Fisheries Service Bulletin* states that the permanent organization of the committee was completed by the election of Dr. Moore as permanent chairman, Dr. Huntsman having been elected permanent secretary at the meeting in Montreal in May. It was announced that the French government, by reason of its investigations incident to the fishery on the Grand Banks from the island of St. Pierre Miquelon, was interested in the work of the committee and would apply for representation.

The records of current drift-bottles released by Canada and the United States on the coast north and east of Sandy Hook were discussed, and the preparation of a report assigned to a committee consisting of Messrs. Huntsman and Bigelow.

Plans were made for the initiation during the coming spring of experiments in tagging cod, haddock and other commercial species of importance in the fisheries of Canada and New England, and tentative arrangements were made for the conduct of other investigations of these fish. The committee adjourned to meet in Toronto in May.

COLLOID CHEMISTRY AT THE UNIVERSITY OF WISCONSIN

THE department of chemistry of the University of Wisconsin desires to call attention to the program for colloid chemistry which will be conducted by Professor The Svedberg during the coming semester (commencing February 1, 1923) and summer session (commencing June 25, 1923).

Professor The Svedberg, of the University of Upsala, will be in residence at the university from February 1 to August 5. He will give two lectures a week on the general theory of colloids and will direct the experimental researches of a number of graduate students during the second semester. In the summer session the course of lectures given during the second semester will be repeated. Every necessary facility will be provided for the successful prosecution of researches. Those desiring to work under Professor Svedberg's personal direction, either during the second semester or during the summer session, should communicate promptly with Professor J. H. Mathews, chairman of the department, since only a limited number can be accommodated. The opportunity of hearing Professor Svedberg's lectures and doing work under his direction during the summer session will appeal to a great many professors and instructors at other educational institutions. A considerable number have already signified their intention of embracing this opportunity.

Professor Svedberg will also conduct a seminary in colloid chemistry which will meet weekly during the second semester. The first half will be devoted to general theory and the second to biological applications of colloid chemistry. In the latter half of the work he will be assisted by Professor Elmer Sevringhaus, of the department of physiological chemistry. Admission to the seminary will be open to chemistry students who have had a course in physical chemistry and who possess at least an elementary knowledge of the theory of colloids, and to advanced workers in the biological sciences.

From June 12 to 15 inclusive a national symposium on colloid chemistry will be held at Madison to which all scientists interested in colloid chemistry are invited. A program of exceptionally interesting papers is now being formulated, and definite assurance of the attendance of nearly all of the most prominent American workers in the colloid field has already been given. About twenty papers will be presented by the authors in person and there will be ample time for thorough discussions. These discussions will be led by Professor Svedberg. More detailed information concerning the program of papers to be presented will appear later in these columns.

DISTINGUISHED SERVICE AWARDS TO CHEMISTS

THE men listed below, formerly connected with or assigned to the Chemical Warfare Service, as we learn from the *Journal of Industrial Chemistry*, have been awarded distinguished service medals for exceptionally meritorious and distinguished service in the following particulars:

Raymond F. Bacon, colonel, C. W. S., chief of Technical Division, A. E. F. Untiring energy, marked scientific attainment and comprehensive technical knowledge in the organization and operation of laboratory units and proving-ground tests.

Karl Connell, major, Medical Corps. Exposed himself unhesitatingly to highest concentrations of deadly gases while working with experimental models and masks. Invented, tested out and perfected a new type of gas mask superior to any then in existence.

Harry L. Gilchrist, lieutenant colonel, chief of the Medical Section, C. W. S., A. E. F. Not only performed services of the utmost value, both to the Medical Department and the Chemical Warfare Service, but developed a degassing unit for treating men exposed to mustard gas which proved so successful that it was adopted for the entire American Expeditionary Forces.

Byron C. Goss, lieutenant colonel, C. W. S., chemical adviser, office of chief, C. W. S., later as chief gas officer of First Corps, and finally, of Second Army. Exceptional ability and wide knowledge of gases; connected with practically every battle in which American troops were engaged.

Joel H. Hildebrand, lieutenant colonel, C. W. S., commandant, C. W. S., Experimental Field, A. E. F. Profound knowledge of chemistry, coupled with rapid grasp of military problems, enabled him to render services of value in determining the best means of using gas and gas materials in the field.

Edward N. Johnston, colonel, Corps of Engineers, assistant to chief, C. W. S., in France from June to December, 1918. Ability of high order in supervision of operations of all gas troops. Later also, to June, 1919, as acting chief of C. W. S. abroad, showed keen business ability and sound judgment in closing the chemical warfare activities of the American Expeditionary Forces.

Gilbert N. Lewis, lieutenant colonel, C. W. S. Secured first-hand data in uses and effects of gas and submitted reports of such value that they became fundamentals upon gas warfare policies of the American Expeditionary Forces. As chief of the Defense Division, he was instrumental in securing more effective gas production, especially mustard gas.

Augustin M. Prentiss, major, General Staff Corps, then major, C. W. S. Knowledge of supplies and material, especially in proper choice of gases, gas shells and other materials used by gas troops and artillery.

John W. N. Schulz, colonel, Corps of Engineers, representative, C. W. S., at general headquarters. Service in the solution of many problems relating to the offensive use of gas and also in planning more effective method for issuance of equipment and training in gas warfare. Later, as chief gas officer of First Army, had entire responsibility of gas warfare in that army during St. Mihiel and Meuse-Argonne offensives.

Richmond Mayo-Smith, lieutenant colonel, C. W. S., chief of Supply Section. Built and administered supply organization consisting of twelve seaport, intermediate and front-line depots, which fully met at all times the demands of chemical warfare supplies which active operations brought upon the service.

Joaquin E. Zanetti, lieutenant colonel, C. W. S., chief liaison officer, C. W. S., with French forces. Familiarity with French language and methods and superior technical ability enabled him to gather an enormous amount of detailed information concerning the manufacture, handling and use of gases.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ALBERT EINSTEIN, of the University of Berlin, has been elected a member of the Russian Academy of Science.

THE Accademia dei Lincei has elected as foreign members the mathematicians Professors E. T. Whittaker of the University of Edinburgh and E. Landau of the University of Göttingen.

THE Indian Mathematical Society has elected to honorary membership Professor G. A. Miller, of the University of Illinois.

AT the meeting of the Royal Geographical Society on December 11, the French ambassador, on behalf of the Société de Géographie of Paris, presented a gold medal to Professor J. W. Gregory for his geographical work in East Africa. Professor Gregory afterwards read a paper on the results of his recent journey in the mountains of Chinese Tibet.

PROFESSOR FREDERIC S. LEE, of Columbia University, has been elected president of the New York Botanical Garden.

AT the Toronto meeting of the American Biochemical Society officers for 1923 were elected as follows: *President,* Professor Philip A. Schaffer, Washington University; *vice-president,* Professor H. C. Sherman, Columbia University; *secretary,* Dr. Victor C. Myers, New York Medical School, and *treasurer,* Dr. W. R. Bloor, Rochester.

AT the fourteenth meeting of the Paleontological Society held at Ann Arbor on December 29 and 30, in affiliation with the Geological Society of America, the balloting for officers resulted as follows: *President,* T. W. Vaughan, Washington, D. C.; *vice-presidents,* W. A. Parks, Toronto, Ontario, W. H. Twenhofel, Madison, Wis., and O. P. Hay, Washington, D. C.; *secretary,* R. S. Bassler, Washington, D. C.; *treasurer,* R. S. Lull, New Haven, Conn.; *editor,* Walter Granger, New York City. Twenty-five papers covering the various sections of paleontology were presented and discussed and fourteen new members were elected, making the total membership of the society at the end of 1922 as 228.

THE Potato Association of America has elected Dr. W. H. Martin, of the New Jersey Experiment Station, as its president; G. C. Cunningham, of the Dominion Department of Agriculture, vice-president, and William Stuart, of the U. S. Department of Agriculture, secretary-treasurer.

DR. EUGENE L. OPIE, professor of pathology at Washington University School of Medicine, has been awarded a fund of $3,000, by the National Tuberculosis Association of New York City, for the further development of his work on tuberculosis.

DR. IRA N. HOLLIS, president of Worcester Polytechnic Institute, has retired as a member of the council of the American Society of Mechanical Engineers. Dr. Hollis, who has just completed six years of service, one as president and five as past president, is succeeded by Dean Dexter S. Kimball, of Cornell University.

OWING to his appointment as British ambassador at Paris, Lord Crewe, who recently accepted the presidency of the British Science Guild, has had to withdraw from this office, but has become a vice-president of the guild and also a member of the committee being formed to make a special appeal for adequate funds to maintain and extend the activities of the guild on behalf of British science. Lord Askwith has consented to accept the presidency of the guild and the lord mayor of London has become a vice-president.

PROFESSOR S. WINOGRADSKY, former director of the imperial institute for experimental medicine in Petrograd, has been appointed chief of a newly organized division of soil microbiology at the Pasteur Institute.

DR. GABRIEL MALDA, head of the national public health department of Mexico, has been appointed vice-president of the National Academy of Medicine.

JOHN OLIVER LA GORCE, associate editor of the *National Geographic Magazine* and trustee of the National Geographic Society, has been elected a vice-president of the society. Mr. La Gorce has been associated with the National Geographic Society since 1905 and has traveled extensively abroad in its interests.

DR. N. H. DARTON, of the U. S. Geological Survey, has returned to Washington after nearly two years' field work completing the geologic map of Arizona for the State Bureau of Mines. While in Arizona the State University conferred on Mr. Darton the honorary degree of doctor of science in recognition of his work on the geology of the southwest.

JOHN F. WORLEY, professor of transportation engineering at the University of Michigan, at a salary less than $5,000, has refused a salary of $25,000 with a large manufacturing concern.

DR. GEORGE H. KIRBY, professor of psychiatry at the Cornell Medical College, has been elected the first president of the recently organized New York Society for Clinical Psychiatry.

THE section on general medicine of the College of Physicians of Philadelphia have elected the following officers for 1923; Dr. Herman B. Allyn, *chairman*, and Dr. Edward J. G. Beardsley, *clerk*. The executive committee of the section, as appointed by the president of the college, consists of Dr. David Hiesman, *chairman*, Oliver H. Perry Pepper and Dr. John H. Musser, Jr.

THE first of the annual series of lectures by the Omega Chapter of the Society of Sigma Xi of Ohio State University was held on October 15, the lecture being delivered by Mr. Thomas Midgeley, Jr., and T. E. Boyd, fuel engineers of the General Motors Research Corporation, upon the subject, "The chemical control of gaseous detonation." The new officers of the Omega Chapter for the current year are James R. Withrow, professor of industrial chemistry, *president;* Edward Mack, assistant professor of physical chemistry, *secretary*, and Thomas Phillips, professor of agricultural chemistry, *treasurer*.

AT a meeting of the Western Society of Engineers held on January 5 in Chicago, Dr. C. A. Kofoid, professor of zoology in the University of California, gave an address on "Preventive medicine and sanitation in relation to human efficiency." In addition, two films were shown: "Unhooking the Hookworm" and "Exit Ascaris," loaned for the occasion by the Rockefeller Foundation and the U. S. Department of Agriculture, respectively.

DR. W. J. HUMPHREYS, as retiring president of the Washington Academy of Sciences, gave an address, on January 9, at the Carnegie Institution, on "The murmur of the forest and the roar of the mountain," in which he discussed several peculiarities of mountain meteorology.

DR. H. W. WILEY, director of the Bureau of Foods, Sanitation and Health of *Good Housekeeping,* gave an address before the American Academy of Applied Dental Science at the annual meeting at Miami, Florida, on January 10, on the "Prophylactic and therapeutic properties of foods."

THE one hundredth anniversary of Pasteur's birth is commemorated in New York at the Academy of Medicine by an exhibit showing the advances in medicine and surgery due to him; the American Museum of Natural History typified by its exhibit the debt which science in general owes to him. There will be a meeting held at the Town Hall, 121 West Forty-third Street, on Sunday evening, January 28, 1923, at 8:15, when the ambassador of France will preside. The speakers and their topics will be Dr. Nicholas Murray Butler, "Pasteur as an educator, patriot and humanitarian"; Dr. John Huston Finley, "The debt of industry and science to Pasteur," and Dr. George David Stewart, president of the Academy of Medicine, "What medicine and surgery owe to Pasteur." No charge will be made for admission and the public is invited to attend.

ON *December* 19 and 20, Marquette University celebrated the Pasteur-Mendel centenary. The first day two lectures were delivered by Professors Locy and Guyer, of Northwestern University and the University of Wisconsin, respectively. The following day lectures were given to the students by members of the faculty dealing with the various aspects of the lives of Pasteur and Mendel. In the evening a banquet was held at the Hotel Pfister, at which time Dr. Joseph Jastrow spoke on mental heredity. The university plans to have the various speeches incorporated in a small volume for distribution.

MR. EDWARD DEGEN, sometime of the staff of the British Museum and the Melbourne Museum, died on December 10, aged seventy years.

THE Marquis of Cerralbo, well known for his achievements in the field of prehistoric research in Spain, has died at the age of seventy-seven years.

PROFESSOR L. L. THURSTONE, head of the department of education and psychology at Carnegie Institute of Technology, Pittsburgh, has been appointed director of research in charge of the Bureau of Personnel Service. The bureau is to be affiliated with the Institute of Government Research, and has been privately endowed subsequent to appeals for its establishment from the United States Civil Service Commission. An advisory board of five members of the national civil service commissions will supervise the operation of the bureau. Mr. Thurstone and his associates will immediately take up the study of the selection, transfer and promotion on a basis of merit of all public service employees; classification of the positions in public service; methods of rating efficiency; reorganization of training courses for federal employees; recommendation of postal clerk and carrier tests; organization and procedure of district offices of the Civil Service Commission, and various other personnel problems outlined by the advisory board. Its field of work covers investigations of state and municipal employee problems in addition to those of the federal service.

THE work of the American Scenic and Historic Preservation Society during the past year was reviewed by Dr. George F. Kunz, its president, at the twenty-eighth annual meeting of the society held at the American Museum of Natural History on January 5. The business meeting was followed by a lecture given under the joint auspices of the society and the museum by Carl E. Akeley on "Beautiful Africa." Dr. Kunz referred briefly to the administration by the society of six state properties—Phillipse Manor Hall, at Yonkers; Stony Point battlefield; John Boyd Thacher Park, west of Albany; Fort Brewerton Reservation, at the foot of Oneida Lake; Battle Island Park, on the Oswego River, and Letchworth Park, on the Genesee River. Plans for the utilization of Diamond Island, at Lake George, which was bequeathed to the society by Mrs. George Foster Peabody, are being made by a committee of which Charles J. Peabody is chairman and George Foster Peabody is one of the members.

DR. FOREST B. H. BROWN, botanist of Bishop Museum, and Dr. Elizabeth Brown, research associate in botany, have recently returned from the Marquesas Islands, where two years have been spent as members of the Bayard Dominick Expedition. All inhabited islands of the group were visited with a view to a thorough survey of the flora. Much new information has been obtained bearing on the geological history of the Pacific insular flora and a study of the food, ceremonial and medicinal plants has thrown new light on the migrations of the Marquesans and of other branches of the Polynesian races. Mrs. Brown gave special attention to the remarkably rich Cryptogamic flora.

The Swedish government has appropriated 60,000 crowns toward the expenses of Dr. H. Lundborg's Institute for Biologic Research on Heredity and Racial Characteristics at Upsala. Dr. Halkrantz has been appointed professor of research on heredity, and Dr. Nillsson-Ehle, professor of statistics. An experimental section for biopathology is planned, and a museum for the collection of data on hereditary factors.

The Stanford University Medical School announces the forty-first course of popular medical lectures as follows: January 12, "Building up resistance to disease: an individual and a community problem," Dr. Philip King Brown; January 26, "Gifted children," Dr. Lewis M. Terman, professor of psychology, Stanford University; February 9, "The problem of the delinquent child," Mr. J. C. Astredo, chief probation officer of the juvenile court; February 23, "The care of the dependent child," Miss Katherine Felton, general secretary, Associated Charities; March 9, "Modern views on dental hygiene in childhood," Dr. Guy S. Millberry, dean of the College of Dentistry, University of California Medical School; March 23, San Francisco's health program for children: "The medical aspects," Dr. William C. Hassler, health officer, San Francisco; "The educational aspects," Mrs. C. W. Hetherington, director of health education, Board of Education.

UNIVERSITY AND EDUCATIONAL NOTES

Princeton University has received a gift of $100,000 from Henry Lane Eno, research associate in psychology, and $25,000 from an unnamed alumnus, for the construction of a psychological laboratory.

By the will of the late William G. Vincent, a fund of $60,000 for establishing a chair of tropical disease at Tulane University of Louisiana School of Medicine, New Orleans, will eventually be available; also, $30,000 for the erection of an isolation building for the Charity Hospital, New Orleans.

On the night of December 16 Robinson Hall, the main recitation building of Albion College, Albion, Mich., was almost totally destroyed by fire. The biological equipment and natural history museum suffered practically a complete loss. The department of biology is temporarily housed in the chemical laboratory. Plans are being made to arrange new quarters for the department to be in readiness for occupation early next fall.

Dr. M. A. Brannon, president of Beloit College, formerly professor of biology at the University of North Dakota, has become chancellor of the University of Montana.

William Mayo Newhall, of San Francisco, and Herbert Hoover, whose home is on the Stanford campus, have been reelected members of the board of trustees of Stanford University to succeed themselves. The Stanford trustees are elected for ten-year terms. Mr. Newhall was also reelected to the presidency of the board.

Dr. A. J. Goldfarb has been promoted to be associate professor at the College of the City of New York.

Dr. Samuel R. Detwiler, who for the past three years has been an associate in anatomy at the Pekin Union Medical College in China, which is under the management of the Rockefeller Foundation, has been appointed assistant professor of zoology at Harvard University, to serve during the second half of the current year. Before going to China, Dr. Detwiler was an instructor in zoology at Yale.

Dr. Hans Zinsser, since 1913 professor of bacteriology at Columbia University and bacteriologist of the Presbyterian Hospital, has been elected as professor of bacteriology and immunology in the Harvard Medical School. Dr. Zinsser, who holds the bachelor and master degrees from Columbia University, as well as the doctorate in medicine (1903), will assume the work in Boston in the autumn.

DISCUSSION AND CORRESPONDENCE

THE PROPOSED ROOSEVELT-SEQUOIA NATIONAL PARK AND THE BARBOUR BILL

In Science for December 22, 1922, on pages 705 to 707, appears an article by Dr. W. G. Van Name headed "A Menace to the National Parks." Those who are familiar with the active campaign which Dr. Van Name has been carrying on against the Barbour bill will take the article at its true valuation. But many other readers of SCIENCE unfamiliar with the facts may receive the wrong impression.

Before starting on a single-handed crusade against a bill which has been carefully considered by competent Government authorities, and endorsed by practically all prominent organizations and individuals interested in the matter, it would have been well to ascertain the facts. This precaution Dr. Van Name does not seem to have taken. The very first statement which he makes is incorrect. The American Association for the Advancement of Science is not represented on the National Parks Committee.

The support of the Barbour bill comes, not from those who do not understand "what the bill will do," but on the contrary, from those who have most investigated the matter. Dr. Van Name's attacks have been effective only where the facts were not known.

The resolution quoted is so unfair and so contrary to the best conservation interests that it has called forth a number of protests, as a result of which the Conservation Committee of the San Diego Society of Natural History has decided to recommend no further action against the bill for the present.

It seems particularly ill advised to speak of the efforts of the Forest Service and National Park Service, each working in the best interests of the public, as a "factional dispute" and "internecine strife." The use of such language displays ignorance or disregard of the broader principles underlying the national parks and national forests, and fosters disagreement among conservationists, to the detriment of both the parks and the forests. The drawing of the proposed boundaries required the adjustment of conflicting desiderata in the best interests of all. We cannot both keep our cake and eat it. There is no more justification for locking up vitally needed resources in a national park with no scenic or other valid claim than there is for attacking the parks in order to exploit them for selfish gain.

National parks are created in order to preserve certain scenic or other features of *national* importance. Since these parks must be kept free from commercial use, the features must be of such outstanding interest as to justify abandoning the resources included within the boundaries of a park. The Sequoia National Park was created in order to preserve the giant redwoods remaining in public control. Unfortunately a large portion of these trees had already passed into private hands; the trees on interior holdings can be cut whether they are surrounded by a national park or a national forest. The publicly owned redwoods will be just as safe under the Forest Service as under the National Park Service. The Forest Service, under its policy of the highest use of all resources, has consistently protected the sequoias under its jurisdiction as being of far more value to the public as monuments of nature's handiwork than as sawn lumber. If further security than the public commitment and consistent policy of the Service were necessary, the redwood groves left outside of the new boundaries could be made National Monuments. Once the protection of the sequoias has been assured, there is no justification for retaining the southern half of the present Sequoia Park. This area is three quarters open hillside of no particular scenic attraction, but of great value for grazing.

The strip of the Yosemite which the National Park Service has asked to have eliminated has been giving the park authorities constant trouble because they have been unable to exclude grazing without undue expense. This is purely a matter of efficient administration; the timber is unimportant and does not enter into the question as Dr. Van Name implies.

Dr. Van Name says (p. 706, first column), "Designs on the fine forests of the national parks are not confined to those of the Sequoia Park." He is laboring under the impression that the Forest Service is deliberately scheming to gain control of all timber on the national parks for exploitation, and that the supporters of the Forest Service are its tools or its dupes. He has stated that the Service is the bitterest and most merciless enemy of the national parks, and has attributed the origin of the Barbour bill to a sinister plot between the Forest Service and the lumbermen. This firmly rooted delusion seems to be the moving force in Dr. Van Name's opposition to the Barbour bill.

The statement near the bottom of page 706, first column, about the forests of the Pacific states will be recognized by those familiar with these forests as wholly misleading. He says, "The immense trees of those forests * * * * * were never found except in tracts of limited extent where they had good soil and other conditions and had escaped serious fire damage for long periods. Those few that still survive are mainly in the hands of the lumber interests and a few years will see the last of them." Obviously he has never traveled through the *national forests* of the Sierra Nevada Mountains where for mile after mile one passes beneath giant sugar pines, western yellow pines, Douglas firs and incense cedars. Nor has he seen the stands of immense Douglas fir, western hemlock and western red cedar on the national forests of Washington and Oregon. True, these large trees will eventually be cut, such of them as survive storm and decay. But has Dr. Van Name never heard of the Mount Rainier National Park with its primeval forests of Douglas fir and associated species, and of the Yosemite with its Sierra forests of sugar pine and other trees?

The Forest Service is in complete sympathy with the movement for preserving areas of virgin forest for esthetic or scientific reasons. Along lakes and much used routes of travel provision is made for leaving sufficient untouched forest to maintain the natural beauties and charm. Undoubtedly, sample tracts of the various kinds of forest will be preserved for scientific and educational purposes.

When the Barbour bill, in its original form permitting water power development, came up for a hearing before the Committee on Public Lands of the House of Representatives, the strongest statement in favor of complete preservation of the national parks was made by Colonel Greeley, chief of the Forest Service. The bill was amended to exclude water power, and obtained the support of the National Parks Committee and other friends of both parks and forests.

The reasons why the Barbour bill has secured such widespread support, outside of the water power interests, may be briefly stated.

There will be added to the already existing Sequoia National Park 961 square miles of land now in a national forest, and there will be returned to the national forest 105 square miles. This represents an exchange very favorable to the national park. As mentioned above, the sequoia groves placed under the jurisdiction of the Forest Service will be amply protected; the land eliminated is about three fourths open and without scenic attractions.

On the other hand the land added to the National Park contains *more publicly owned redwoods exceeding ten feet in diameter than the area returned to the national forest.* The present Sequoia Park contains 1,214 of such trees, and the Roosevelt-Sequoia Park will contain 1,304, a net gain of ninety trees, besides those outside the boundaries which will still be protected. Aside from the giant redwoods, the 961 square miles to be added contain three or four times as much of the main forest belt, at from 4,000 to 9,000 feet elevation, as the area eliminated, with larger and finer trees. The fact that these trees may be located in mountains difficult of access for logging operations, and may therefore be of little commercial value, does not detract from their scenic and scientific interest.

The jog in the boundary, against which Dr. Van Name protests, was made to leave out lands which do not properly belong in the Park. How this perfectly natural condition, over which obviously man has no control, can injure the new Park is difficult to see.

The Roosevelt-Sequoia National Park will contain, in addition to Mt. Whitney, Mt. Tyndall, and other magnificent peaks, the superb canyons of the Tehipite and Kings River, considered by many as equal in grandeur to the Yosemite. This fact Dr. Van Name has persistently ignored. Water power interests are eager to dam and flood these canyons and have already filed applications for this purpose. Dr. Van Name's activities, though doubtless from an entirely different motive, play directly into the hands of the water power interests and other enemies of the National Parks. If he should be successful we will see these beautiful canyons ruined by dams, conduits, power lines, etc., instead of included in one of our finest National Parks.

Barrington Moore

New York, N. Y.

THE PALEOPATHOLOGY OF THE FOSSIL INVERTEBRATES

THE recent volume by Edgar Dacqué, professor in the University of Munich,[1] gives some interesting evidences relating to the paleopathology of the fossil invertebrates, but are so hidden under the misleading title of the book that there is need of calling especial attention to them for those interested in ancient evidences of disease.

His discussion of matters relating to paleopathology is given under two headings: (1) Epökie, Parasitismus, Symbiose, pp. 457-476. (2) Regeneration, pathogene Schalen, Häutung, pp. 693-703. Dacqué finds it necessary to discuss the meaning of the unusual term, *Epökie*, and one wonders why he did not use some well-known term, of which there are several, with the same significance. He defines the term, Epökie, as restricted to those cases in which an animal lives attached to the outside of another living animal. He points out the difficulty of properly interpreting these evidences which are forerunners of diseased conditions.

The treatment of ancient evidences of parasitism is not nearly so complete as that given by Dr. John M. Clarke[2], but is an interesting résumé, illustrated by numerous European and American examples, with bibliographic references. One illustration is very interesting. It is a pathologic carapace of a Cretaceous crab, possibly infested by some member of the family Bopyridæ, which inhabit the branchial cavities of other Crustacea, a habit they are known to have had in the early Pleistocene also. The specimen, derived from the middle Cretaceous of England, was described by Th. Bell in 1862.

It is difficult to understand why Dacqué uses the term *pathogene* instead of the more appropriate term *pathologische,* adopted by all other German writers on paleopathology. There is certainly nothing *pathogenic* about either the injured snail or the diseased sand-dollar, from the Oligocene and Miocene respectively, shown on page 699. His studies in regeneration are rather incomplete and largely restricted to European evidences, but on the whole Dacqué's work is to be commended for the attempt to gather evidences relating to the early phases in the evolution of disease. It is worthy of note that such evidences can be satisfactorily sifted only by one who has a wide acquaintance with fossil invertebrates, since rare judgment must be displayed to avoid numerous possible misinterpretations.

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[1] "Vergleichende biologische Formenkunde der fossilen niederen Tiere," Berlin, 1921. The cumbersome circumlocution forming the title was evidently used to avoid the repetition of the term *Palæobiologie,* which would be a more exact title but which was adopted by O. Abel in his "Grundzüge der Palæobiologie der Wirbeltiere," Stuttgart, 1912. The two volumes supplement each other in a wonderful way and form a complete and adequate discussion of the paleobiology of all fossil animals.

[2] "Organic Dependence and Disease: Their Origin and Significance," New Haven, 1921.

QUOTATIONS

ACROSS THE SAHARA BY MOTOR

THERE is a twofold interest in the attempt to cross the Sahara which is about to be made in Citroën motor-cars. The greater part of the world loves an adventure almost in proportion to its apparent foolhardiness. The brave Frenchmen who next month are to leave the railhead at Tuggurt, in South Algeria, for Timbuctoo are undertaking a journey of over 1,800 miles through a trackless desert, in a region of burning sun by day, of piercing cold at night. Trying to follow the same route by the swifter aeroplane, General Laperrine perished miserably, after a forced landing, and Major Vuillemin succeeded, but only after terrible adventures. Better preparations have been made for the motor-car party. Citroën cars have already been to In Salah and back, a stretch of over five hundred miles, at the northern end of the route, where wells exist and stores of petrol have been placed. At the southern end, along the Niger to Burem, and across the desert to Kidal, a stretch of over three hundred miles, and possibly even farther, stores have been placed in readiness. But for the central "trek" the expedition must be self-dependent. Let our home-fed imagination not picture the desert as a plain of sand, smooth, except for the ribbing of the wind. It is a rugged country scored by ravines, barred with mountains, and the black rocks show their teeth even in the plains. The shifting sands lie in drifts and beds often most treacherous where they seem most secure, adding to the dangers of the traverse, like wind-blown snow on a rocky slope. And so the mechanical side of the expedition will be watched with an eager curiosity. The cars to be used have the standard ten horse-power engines of the popular Citroën four-seater touring cars. They are fitted with a special gear-box giving a range of speed from two to twenty-five miles an hour, and provided with a ribbed caterpillar of canvas and rubber which has already been tried successfully on loose sand. It will be a striking testimony to the enterprise and workmanship of the Citroën Company if cars of a type produced in bulk and sold at the price of £245 in this country are able to stand a test so severe.—The London *Times*.

SCIENTIFIC BOOKS

American Indian Life, by several of its students. Edited by Elsie Clews Parsons. Illustrated by C. Grant Lafarge. New York: B. W. Huebsch, 1922.

I do not now mind confessing that when I first saw this book I felt somewhat suspicious of it, but no sooner had I begun to read it than I became greatly interested and my pleasure increased as I read more of it. We are often told that every man has the making of one good novel. Sometimes this succeeds in being born into the world, usually it does not, but too frequently there is a prolific output of indifferent offspring. There are many books of sympathetic studies in narrative form of native races, which are invaluable as records of alien psychology and of varied customs, but naturally the author confines himself to the people he knows and each book is therefore about the one particular people. This volume is a new departure as it comprises a series of interpretative studies of aboriginal life written by experts. It would not be just to compare the treatment of their subjects by the several authors. Each has its own individuality and it is highly interesting to see how those whom we know personally, or who are known to us by their scientific studies have "let themselves go" and how they reveal themselves in their endeavor to reveal others. One and all are to be heartily thanked for thus giving us of themselves.

It really was a brilliant idea of the Editor, Dr. Elsie Clews Parsons, to induce serious field-workers for the nonce to discard the precise method of a descriptive monograph and to recast their first-hand material in the form of a narrative, which is none the less scientific though presented in a manner which is attractive to all sorts and conditions of men To paraphrase the remark of Professor Kroeber in the Introduction: Every anthropologist with field experience holds in his memory many interpretations, many convictions, as to how his natives feel, why they act as they do in a given situation, what goes on inside them. This psychology is often expressed by the frontiersman, the missionary, and the trader, but it has been very little formulated by the very men who know most. I can well believe, as Kroeber goes on to say, "that the writing of our tale has been a surprise and of value to ourselves. We had not realized how little we knew of the workings of the Indian mind on some sides, how much on others * * * Each author has adhered strictly to the social facts as he knew them. He has merely selected those that seemed most characteristic, woven them into a plot around an imaginary Indian hero or heroine. The method is that of the historical novel, with emphasis on the history rather than on the romance." Indeed all the remarks by Kroeber on the book as a whole are much to the point. May I, however, be forgiven if I demur to one or two statements? He adopts the view current among American anthropologists that "fundamentally one physical type stretches from Cape Horn to Alaska; superficially it is intricately variegated—here with round heads, there with long * * * In fact, it might seem that during ten thousand years the variety of climates and habitats might have succeeded in moulding the Indian into racial types of even greater distinctness than we encounter." I doubt if any European anthropologist would agree that the Lagao Santa type was merely a local variation of the "proto-Mongoloid stock" which gave rise to the typical brachycephalic peoples of America. The Lagoa Santa type is admittedly an ancient one, and it seems much more probable that it represents a very early migration into America of a non-Mongoloid stock, and probably before the Mongoloids arrived. Again, the dolicho-mesaticephals of the woodlands and plains of North America seem to indicate a different racial movement from that of the western and southern American brachycephals. He also adheres without comment to the popular view that all the culture of Central America and of Peru was rigidly indigenous; but this is not the place to discuss this thorny subject. "British Colombia" is evidently a printer's error which has crept in on p. 10.

After this little grumble I can return to the book itself. A map on page 379 gives the distribution of the tribes described and one sees at a glance how representative they are. An appendix gives a brief account of the distribution of each tribe, and very useful bibliographies. By Mr. C. Grant Lafarge (whose name strangely enough appears only on the title-page, the Editor and Introducer might profitably have alluded to him or his plates), the book is embellished with six colored plates and 19 uncolored, which are explained by the "Illustrator's notes" at the end of the volume. They are mostly of a decorative character, but the artist has evidently been at pains to be accurate in detail and color.

Writing as a teacher of, alas! now long experience, I have no hesitation in stating that this should be the first book to be placed in the hands of a beginner in the study of North and Central American ethnology. When he has read this, he will be able to read textbooks and original treatises with much more profit and comprehension, as he will be equipped with a sympathetic human background which will illumine the more systematic works which he will have to study. There is no better survey of Indian custom and belief for interesting the general reader in the vanished life of the earlier inhabitants of his country. It is to be hoped that the large size and expense of the book will not seriously diminish its sale, for it certainly deserves a wide circulation.

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SPECIAL ARTICLES

AN IMPROVEMENT IN MUSCLE CONTRACTION APPARATUS

ONE of the difficulties encountered in recording a series of muscle contractions is due to the fact that the relaxation phases very seldom happen to stop on the base line; hence the curves are not exactly comparable and it is difficult to make comparisons. It is thus often desirable to be able to adjust the writing point of a lever to the base line on a revolving kymograph and at the same time not otherwise interfere with the experiment. The apparatus described in this paper enables one to do this easily, quickly and accurately. It has been used with satisfactory results on smooth muscles such as the esophagus, stomach, intestine and oviduct of the frog; regions of the esophagus and stomach of the turtle, and the circular muscles of the body wall and intestinal tract of the earthworm.

The principle involved is that of raising or lowering the fulcrum of the writing lever by means of a micrometer screw. This adjustment is of special advantage when stimuli are being made at regular intervals of time and when the stretch of the muscle is considerable or the relaxation phase is slow or long drawn out. By use of this apparatus one is able to make these corrections at will by raising or lowering the writing point to the base line while the kymograph is running.

The main support of the apparatus is the iron bar indicated by letter *A* in figure 1, which may be clamped on to a ring stand. At right angles to *A* are two parallel bars, *B* and *R*. The former and shorter one is rigid and firmly

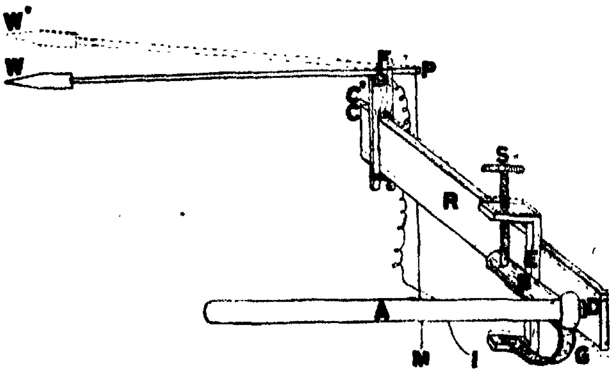

FIG. 1

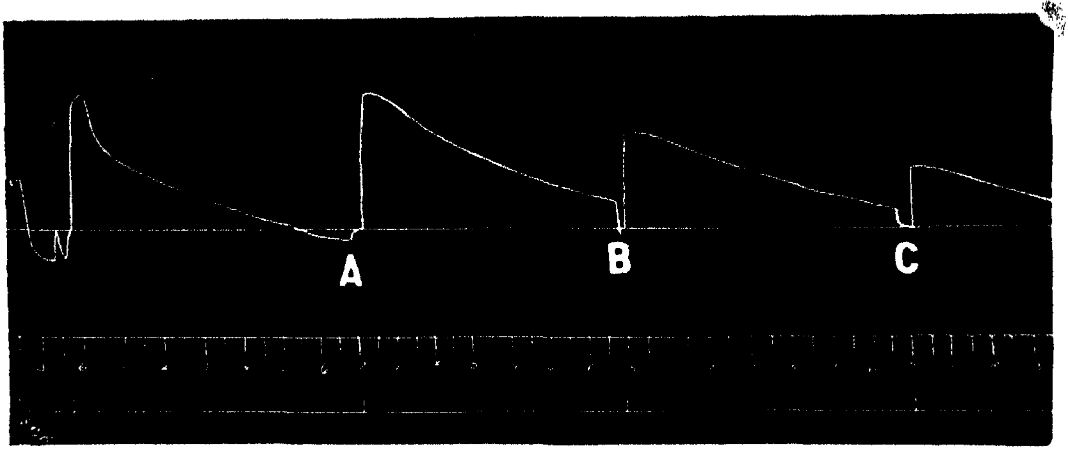

FIG. 2

attached to *A* near its distal end. The latter fits on the distal end of the bar *A* and turns on it as on an axis at *D*. Firmly attached to *R* about one fourth of its length from *D* is a rigid piece *E*, both ends of which are bent at right angles to its main axis. Through its upper end passes a micrometer screw *S*, which is so arranged that when turned clockwise it strikes the bar *B* and thus raises the pieces *E* and *R*. The point *C* is raised to *C'* and hence the fulcrum *F* is also raised. To the lower end of *E* is firmly attached the lower end of a horseshoe shaped steel spring *G*. The upper end of the spring presses against the lower side of the rigid bar *B*. When the screw is turned clockwise, *E* and hence *R* and *F* are raised and the two ends of the spring are forced closer together. When the screw is turned counter clockwise the spring forces the lower end of *E* down, hence *R* and *F* are lowered.

Standardized loops of the muscle to be stimulated were mounted as follows: Two equilateral triangles of about one centimeter on each side of fine copper wire, about No. 24, were made in such a way as to form a sort of safety pin, with a hook-like clasp at one end. By running the free ends of each triangle through the loop of tissue and clasping the triangles, a desirable support for the tissue was made. One of these triangles was then attached at *M* to a copper wire extending to the short arm of the lever at *P*. The other triangle was looped over a small hook extending through the stopper in the bottom of the glass chamber in which the muscle was placed. These supports also served as contact terminals for the electric current, while the short arm of the lever *F P* and the copper wire extending from *F* to *I* completed the circuit.

Figure 2 is a series of curves of a muscle stimulated at regular intervals of seven minutes (by an electrical current of constant strength and duration) showing how the writing point may be adjusted either up or down to the base line, without interfering in any other way with the experiment. In this particular series the muscle consisted of ten segments of the body wall of an earthworm, taken between the sixtieth and seventieth segments back of the clitellum and immediately mounted as described above and immersed in normal sodium chloride solution. Eight minutes after mounting, the normal sodium chloride was removed and 0.5 per cent. ethyl alcohol added; after 1¼ minutes the electrical stimulus was applied and likewise after three successive intervals of seven minutes each. Adjustments of the writing point were made at *A, B* and *C*, immediately preceding the limit of the seven minute time interval between the stimuli. These corrections may be made either up or down with equal ease. By this means the curves are more accurately standardized and more nearly comparable from the fact that each starts from the base line.

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SCIENCE

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Boston, December 26-30, 1922

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE PERMANENT SECRETARY'S REPORT ON THE BOSTON MEETING

GENERAL FEATURES

THE seventy-sixth meeting of the American Association for the Advancement of Science and of the associated scientific societies came to an end in Cambridge, Massachusetts, on Saturday, December 30, having been opened on the evening of Tuesday, December 26. This was the annual meeting of the association year 1923, for the association year begins October 1. It is accounted the fourth Boston meeting, although the first meeting after the organization of the association was held in Cambridge. More correctly, the meeting just ended was the fifth Boston meeting.

As a great convention of American men and women of science, as an exposition of American scientific work and in every way the meeting was entirely successful. In attendance it almost equalled the Chicago meeting, held in December, 1920, which is recorded as having had the largest registration (2,413) in the history of the association. No past meeting has been the equal of the seventy-sixth with respect to the completeness with which the numerous fields of science were represented on the programs, and this is also true with respect to the arrangement of the meeting places and the convenience of the facilities for the numerous section and society sessions.

The total number of persons who registered at the Boston meeting is 2,339, and it is apparent that a large number were present who failed to register. The registration by regions is shown below:

The United States

Alabama	8	Dist. Columbia	125
Arizona	3	Florida	5
Arkansas	4	Georgia	8
California	18	Illinois	79
Colorado	6	Indiana	18
Connecticut	92	Iowa	18
Delaware	7	Kansas	8

Kentucky	6
Louisiana	5
Maine	43
Maryland	41
Massachusetts	838
(Boston and Cambridge, 562)	
Michigan	48
Minnesota	27
Mississippi	3
Missouri	19
Montana	4
Nebraska	3
New Hampshire	49
New Jersey	60
New Mexico	1
New York	327
North Carolina	7
North Dakota	4
Ohio	62
Oklahoma	2
Oregon	4
Pennsylvania	116
Rhode Island	62
Tennessee	8
Texas	8
Vermont	22
Virginia	17
Washington	1
West Virginia	13
Wisconsin	31

Other Countries

Australia	1
Belgium	2
Brazil	3
Canada	75
Czecho-Slovakia	3
China	11
England	1
Guatemala	1
Hawaii	3
India	1
Japan	2
Norway	1
Panama	1
Philippine Islands	5
Porto Rico	1
Russia	1
Siam	1
Switzerland	1
South Africa	1

All of the fifteen sections of the association were well represented in the programs, and thirty-two societies met with these. Of the societies meeting at Boston, twenty-seven are associated with the association, including twenty affiliated societies. Altogether, one hundred and forty-one scientific sessions were held, as well as a large number of business sessions, committee meetings, dinners, luncheons, smokers, etc. No field of scientific endeavor was wholly unrepresented in the great array of papers and addresses that were given.

This meeting was held on invitation of the Massachusetts Institute of Technology and Harvard University. Most of the sessions were held in the main buildings of the Massachusetts Institute, which are so arranged as to furnish very exceptional facilities for this kind of convention. Some of the sections and societies met at Harvard University, including about thirty of the one hundred and forty-one sessions. A few were held at the State House and a few at hotels. The registration room, the council room and the offices for mail, etc., were located in the Pratt Memorial Building on Massachusetts Avenue. With very few exceptions all session rooms were under the same roof with the registration room, and it was generally not necessary to go out of doors in order to pass from one meeting place to another. This feature was greatly appreciated, especially on Wednesday, Thursday and Friday, which were cold, with wind and snow. Excellent luncheons were very efficiently served in the Walker Memorial Building, a short distance from the main group of buildings. Altogether, the session rooms and other facilities were as nearly perfect as any that the association has ever enjoyed. A large and efficient corps of guides made it easy for those in attendance to find their way from place to place in the enormous but very simply arranged series of rooms and corridors. The fine hospitality of the Institute of Technology, Harvard University and of the Boston friends of science, which made the meeting such a pronounced success, was greatly appreciated.

The excellent preliminary arrangements were made by the local committee for the fourth Boston meeting, the members of which took up this important work last spring. During the last two months before the meeting the committee and its subcommittees were necessarily very busy indeed. A considerable fund was raised by subscription to cover the extra expense of the meeting. The association members and the friends of science in Boston responded very generously, and the association wishes to express here its appreciative thanks to these supporters, one and all.

To the staff of the Massachusetts Institute of Technology the hearty thanks of the association are due for the free use of their offices and classrooms and for the fine and inspiring exhibition of the institute laboratories on Wednesday afternoon. The association is greatly indebted to Harvard University, also, for the use of some of its rooms, and especially for the very pleasant and profitable Harvard Day, Thursday, with its very enjoyable luncheon.

The local committee consisted of the following members: S. C. Prescott, *chairman*, A. L. Townsend, *secretary*, Everett Morss, *treasurer*, H. S. Ford, *assistant treasurer*, Frederick L. Allen, G. C. Anthony, I. W. Bailey, Geo. H. Barton, R. P. Bigelow, Miss A. F. Blood, Mrs. E. P. Cunningham, L. J. Henderson, A. F Holmes, Alexander Inglis, E. S. King, A. B. Lamb, Waldemar Lindgren, H. E. Lobdell, Theodore Lyman, Mrs. R. C. Maclaurin, H. V. Neale, J. F. Norris, C. L. Norton, W. J. V. Osterhout, G. H. Parker, Nathan van Patten, H. Shapley, H. W. Tyler, W. M. Wheeler,

E. C. Wilm. The subcommittees were as follows: *Hospitality,* C. L. Norton; *Entertainment,* J. F. Norris and A. B. Lamb; *Hotel and Dinners,* A. L. Townsend; *Transportation,* H. S. Ford; *Meeting Places,* S. C. Prescott and A. L. Townsend; *Exhibits,* R. P. Bigelow; *General Program,* S. C. Prescott; *Publicity,* F. L. Allen and H. E. Lobdell; *Membership,* G. H. Barton; *Registration,* A. F. Holmes. Each section of the association and each society that met with the association at Boston was locally represented by one or more persons who cared for its special needs, in consultation with the local committee and the sub-committees. To all of these local representatives, as well as to the local committee and the subcommittees, the cordial thanks of the association and of the associated societies are here expressed. It is a pleasure to record here specially the very efficient work of Professor Prescott, Mr. Townsend and Mr. Allen, whose untiring services to the association continued throughout the meeting. A report of the local committee will be made to the permanent secretary for the use of future local committees.

The general secretary and the permanent secretary visited Boston at the end of November to help the local committee in the final stages of the general preparations, and the preliminary announcement of the meeting was published shortly after the permanent secretary's return. It was sent to all whose names were at that time on the roll of the association. The announcement is larger than any earlier association publication of this kind, containing seventy-eight pages, and many members expressed their gratification as to its form and completeness. A new feature, introduced for the first time in this announcement, is a twelve-page preliminary account of the session programs, as far as information about these was available at the time. It is planned for the future that the features about which members wish to be informed early will be published separately from the rest of the announcement and much earlier than it is possible to issue the program notes. They will probably appear in the columns of SCIENCE about November 1.

The general program of the fourth Boston meeting, an attractive book of 158 pages in a gray paper wrapper with red lettering, was ready for distribution before noon on Tuesday, December 26. In excellence of style and typographical work, as well as in size, it surpasses all earlier programs published by the association. The usefulness of the program was greatly enhanced by a summary of events, arranged by session periods, inserted just before the program pages. This valuable feature of the program enabled each person to determine at a glance which of the many simultaneous sessions he might wish to attend.

To the section and society secretaries and other section and society officers we owe the programs themselves, and it is fitting that appreciative acknowledgment be here made of their tireless and continued work in arranging the programs, a work that needs to be accomplished mainly in a very short time just before the meeting and frequently involves considerable difficulties.

That the general program is serving a useful purpose is shown by the fact that an increasingly large number of those in attendance are coming to rely on it almost exclusively. It may be regretted that the publication of so many separate society programs is necessary for these meetings, and it might be worth while to consider whether arrangements can not be made by which the societies would depend wholly upon the general program and reprints thereof, which might be furnished to the societies at a very low cost. No small saving might thus be accomplished.

The most serious difficulty involved in the preparation of the general program was, as usual, due to the fact that many of the associated societies are obliged to leave their programs open until very late, so that manuscripts for these were in many cases not received until a few days before the printing of the program. All of the printing was done in the last week before the opening of the meeting. The work of editing was largely performed by the assistant secretary, who was in Boston during the entire week just before the meeting, attending to this work.

Copies of the Boston program will be sent to members who remit five cents for postage to the permanent secretary's Washington office.

The official badge for the meeting was a small celluloid button, about two centimeters in diameter, a red-bordered, silver circle, with the legend "A. A. A. S., Boston, 1922."

Besides the badge, the general program and an additional copy of the preliminary announcement, each person registering at the Boston meeting received, with the compliments of Ginn and Company, a copy of Edwin M. Bacon's "Boston, a guide book to the city and vicinity," an attractive book of about one hundred and fifty pages, bound in red cloth with gilt lettering and containing numerous illustrations and maps as well as interesting accounts of historic landmarks, etc. For the thoughtful courtesy of the donors of this little book were expressed the sincere thanks of the association, of the associated societies and especially of all persons who attended the meeting. It added much to the pleasures and profits of the meeting period.

Exhibition of Scientific Apparatus and Products

A very satisfactory exhibition of scientific apparatus and materials was held throughout the meeting, in the large drafting room on the fourth floor of the main building of the institute. This was in charge of Professor R. P. Bigelow, whose efficient services in this connection were very greatly appreciated by all in attendance. A number of well-known firms and institutions took part in the exhibition, and excellent opportunity was afforded to view materials and specimens of various kinds and to observe apparatus in operation. The exhibition included clear and opaque fused-quartz, optical glass, insulators, instruments for long-range transmission of light, microscopes, projection apparatus, telescopes, electric ovens and other electric appliances, geological models and relief maps, chemical apparatus and biological specimens and models.

Exhibits pertaining to the sessions of a number of the sections and societies were to be found in rooms near the corresponding meeting places. In connection with the meeting of Section L an exhibit was shown that included books, photographs, engravings and other objects of interest in relation to the history of science, especially a collection of historical books on physics. The American Society of Zoologists exhibited microscopic preparations, living and preserved zoological specimens, manuscripts and drawings. The American Association of Economic Entomologists had an extensive exhibit pertaining to insect pests and their control. The Botanical Society of America, the American Phytopathological Society, the Sullivant Moss Society and the Ecological Society of America displayed interesting collections of books, microscopical and other preparations, drawings and charts, and living as well as preserved biological specimens.

A special exhibition of the institute laboratories in operation was held on Wednesday afternoon. The visiting members of the association were afforded an excellent opportunity to inspect the entire group of magnificent buildings and laboratories belonging to the institute. Guides directed visitors to the various places of interest, and members of the faculty and staff were in attendance to explain special features.

Social and Entertainment Features of the Meeting

Among the many social and entertainment features of the meeting should be mentioned the following:

A general reception in Walker Memorial Building following the opening exercises on Tuesday evening.

Tea was served by the Boston women in the Emma Rogers Room of the Massachusetts Institute of Technology on the afternoons of Wednesday, Thursday and Friday.

The American Academy of Arts and Sciences of Boston held open house, throughout the meeting, for members of the association and their friends. Tea was served each afternoon.

The College Club of Boston extended the privileges of its drawing rooms and restaurants to visiting women and their friends, throughout the meeting.

The library and reading room of the Affiliated Technical Societies of Boston was open to visitors for the meeting.

On Wednesday afternoon the Museum of Fine Arts was open to those attending the meeting, and efficient guides conducted visitors through the Museum. Tea was served by the women connected with the Museum.

The laboratories of the Massachusetts Institute of Technology were open to the inspection of visitors on Wednesday afternoon, and members of the staff were present to explain the many interesting and instructive features.

Thursday, December 28, was Harvard Day. Visiting members and their friends were guests of the university, and courteous guides conducted parties to points of interest. A complimentary luncheon was served in Memorial Hall.

On Thursday evening there was an exhibition of educational motion pictures, the films being furnished by the Society for Visual Education, of Chicago; and Dr. F. R. Moulton, professor of astronomy in the University of Chicago and secretary of the society, spoke with reference to the pictures that were shown.

Women interested in scientific work had a luncheon on Friday at River Bank Court, and Miss Anne S. Young, of the astronomical department of Mount Holyoke College, spoke in an interesting and inspiring way on the part to be played by women in science.

The board of trustees and the librarian of the public library of the city of Boston were the hosts of association members and their friends on Friday afternoon. Docents conducted groups of guests through the central building on Copley Square, and tea was served in the staff room.

The Northeastern Section of the American Chemical Society tendered a complimentary smoker to members of Section C (Chemistry) on Friday evening.

By special invitation a number of those attending the meeting visited the Massachusetts Agricultural College at Amherst on Friday and Saturday.

The buildings of Wellesley College, at Wellesley, Massachusetts, were open, by special invitation, to visitors on Saturday afternoon, and tea was served informally in the Shakespeare House.

A number of those in attendance at the meeting, especially those of Section K (Social and Economic Sciences), visited Wellesley Hills on Saturday on special invitation of the Babson Institute and the Babson Statistical Organization. Motor cars were provided for a visit to the new campus and buildings of the Babson Institute and a complimentary luncheon was provided at the Club House.

Dinners and Banquets

Every evening of the meeting was characterized by one or more dinners held by the various groups of men and women of science who were in attendance. On Wednesday occurred the Ladies' Dinner of the American Mathematical Society. On the same evening were held the Ecological Society dinner and the annual dinner of the Society of Sigma Xi.

On Thursday were held dinners for the following groups: the mathematicians, the zoologists (with the address of the retiring president of the American Society of Zoologists and the retiring vice-president for Section F, American Association for the Advancement of Science, Dr. C. A. Kofoid), the botanists (with the address of the retiring president of the Botanical Society of America, Dr. C. E. Allen), the anthropologists, the psychologists (with the address of the retiring president of the American Psychological Association, Dr. Knight Dunlap), and the agronomists. The American Nature-study Society held a dinner on Thursday in honor of Mrs. Anna B. Comstock, who has long been professor of nature-study in Cornell University. The banquet of the New England Forestry Congress was also held Thursday evening, and visiting students of forestry were invited.

The following groups held dinners on Friday: the physicists, the entomologists, the phytopathologists, the naturalists (with the address of the retiring president of the American Society of Naturalists, Dr. W. M. Wheeler), and the Gamma Alpha Graduate Scientific Fraternity.

The dinner of the Metric Association occurred on Saturday evening, followed by an informal session of the association, at which a number of speakers addressed those in attendance.

Publicity Arrangements at Boston

The public arrangements at the fourth Boston meeting were very excellent indeed, much more efficient than those at any earlier meeting of the association. The publicity office in the Pratt Memorial Building was in charge of Mr. Frederick L. Allen, secretary to the Corporation of Harvard University, who acted as chairman of the subcommittee on publicity, American Association for the Advancement of Science. He organized an efficient corps of workers, who prepared mimeograph copy on the various papers and addresses, having resulting sheets promptly ready for the representatives of the daily press. The result was a very satisfactory example of this kind of publicity work, which by its very nature is exceedingly difficult. The newspapers of Boston and many other large centers as well gave much space to the association throughout the week. Especially did the

Boston *Transcript* give a fine service to science and education and to the association.

Mr. Allen and his subcommittee on publicity received much help from Science Service, which again cooperated in a very fine spirit with the association in its endeavors to spread the scientific news of the meeting and to arouse public interest in the work of our organization. Science Service is an institution established in Washington under the control of the American Association for the Advancement of Science, the National Academy of Sciences and the National Research Council. Its sole purpose is to disseminate scientific information through the newspapers. Its editor, Dr. Edwin E. Slosson, was present throughout the meeting, taking part in the work of the publicity office. The valuable help received on this occasion from Dr. Slosson and from Mr. Watson Davis, also of Science Service, is greatly appreciated by the association.

A letter requesting advanced abstracts of papers to be given at the approaching sessions was sent out by Science Service to every person whose name appeared in the session programs, just as soon as the manuscripts for these programs were received by the permanent secretary's office. On the arrival of each program manuscript, copies of this letter were sent to all whose names appeared in the program, and most of the letters were sent out in ample time for replies to be received in Washington by Science Service a week or more before the opening of the meeting. As the abstracts came in, copies were promptly forwarded, in daily batches, to Mr. Allen at Cambridge, and his publicity office thus came into possession of a large amount of advance material to work upon, which was used to great advantage. Altogether, nearly 250 abstracts were received, during the period from December 7 to the time of the meeting. The permanent secretary wishes here to express the thanks of the association officers and Science Service to the members who responded promptly to the "blue sheet" request for advance abstracts. To the pains thus taken at a crowded and busy time by so many of those who were to speak at the meeting is largely due the pronounced success attained by our publicity office at Boston.

Besides the great service performed by Mr. Allen and his staff, mainly through the local press, Science Service prepared and sent out under release date 59 advance accounts covering the meeting. These were in the *Daily Science News Bulletin* regularly sent out by the Service to nearly 50 daily newspapers and magazines, reaching perhaps between two and three millions of readers throughout the United States. In addition to this advance mail service in the *Daily News Bulletin*, Science Service telegraphed a 500 word account of the meeting to each of 14 large dailies for each morning and evening of the first four days of the meeting. In all Science Service disseminated not less than 100 different accounts based on the Boston meeting.

The association and the associated societies may well congratulate themselves on the growing success of their publicity work during recent years, and especially on the unprecedented success of this work at Boston. This aspect of our work has an importance to men and women of science and to the public as a whole that must be regarded as equal to that of any of the other lines of endeavor in which our organization is engaged. It is planned to attempt still further improvement in our publicity work at future annual meetings.

The General Sessions

The seventy-sixth meeting was formally opened on the evening of Tuesday, December 26, in the main hall of Walker Memorial Building. Addresses of welcome were made by Dean H. P. Talbot, of the Massachusetts Institute of Technology; by Dr. T. W. Richards, representing President Lowell of Harvard University; by the mayor of Boston, Mr. James M. Curley, and by the mayor of Cambridge, Mr. Edward W. Quinn. These speakers were introduced by Professor S. C. Prescott, chairman of the local committee for the fourth Boston meeting. Following the addresses of welcome, Dr. J. Playfair McMurrich, president of the association, took the chair. He introduced the retiring president, Dr. Eliakim H. Moore, who delivered his address on "What is a number system?" By way of introduction Dr. Moore emphasized the great progress made by American science during the last 74 years and by the association, which was organized as a result of the Cambridge meeting of the American Association of Geologists and Naturalists, held in September, 1847. Then, addressing himself as a representative of pure mathematics to the devotees of the natural sciences, Dr. Moore raised the question of the distinction between mathematics and the natural sciences. He pointed out that, although mathematics is simpler and more self-contained than are the other sciences, it is not absolutely self-contained; in its development it constantly receives stimuli from non-mathematical sources. Though mathematics has impressed itself profoundly on other sciences by its ideal of mathematical rigor, and though it is perhaps the typical science, the fundamental science, yet it should not be separated from the natural sciences on the ground of method, as expressed in the view commonly held that mathematics is deductive and the natural sciences are primarily inductive. To show how this view is contradicted by the history of mathematics, the speaker, in response to the question "What is a number system?" undertook to give an impressionistic descriptive view of the historical development of the fundamental notion of number. It was emphasized that the separation of mathematics from the natural sciences should be considered as based on subject matter, not on method. Every branch of science, mathematics included, has its continually interplaying inductive and deductive phases. Mathematics, as simpler, more self-contained and earlier developed, hopes to be of value to all sister sciences, not only by means of specific results, but also by the development of general methods capable of application in many fields of knowledge.

The opening exercises were followed by a general reception given by the Corporation of the Institute of Technology to the president and retiring president of the association. There was a large attendance, and the occasion was a very enjoyable and profitable one. Refreshments were served in the galleries of the main hall.

A joint session of the association and the Society of Sigma Xi formed the second general session, held on Wednesday evening, December 27. The address on this occasion was on "The nation and its health" by Dr. Livingston Farrand, president of Cornell University. Dr. Farrand reviewed the progress of public health work in this country and pointed out that since 1870 the average length of life has been increased by fifteen years, that marked reduction has occurred during this period in infant mortality and in mortality due to tuberculosis, typhoid, smallpox and many other diseases. The efforts of health workers and organizations have, however, been unable thus far to prevent increases in certain unconquered diseases, such as cancer and diseases of the heart and kidneys. The most outstanding problem at present concerns the control of the degenerative diseases of later life, an increase in mortality from these being an inevitable consequence of improvements in the control of diseases of infancy and youth. Dr. Farrand outlined the organized movements in this country for the further improvement of public health and urged that scientific men support these movements in every feasible way.

At the third general session, held on Thursday evening, an illustrated public lecture on "Lessons from the Grand Canyon" was given by Dr. William Morris Davis, emeritus professor of geology in Harvard University. Professor Davis emphasized the prediction that the widening of the Colorado Canyon by erosion will not stop until all the neighboring highlands shall have been laid low and the whole region tributary to the river shall have been reduced to a nearly featureless plain, sloping very gently toward the river mouth. Furthermore, the rock structures forming the wall of the canyon are outspoken witnesses to the occurrence of five long antecedent cycles of erosion before the present cycle began. Professor Davis pointed out, moreover, that the long periods of past time recorded by these alterations of vast erosions and depositions were themselves preceded by a still longer period during which the complex rocks, seen in the basal portion of the gorge, were formed. The lecture was accompanied by a series of wonderfully perfect lantern slides that brought out very clearly many of the features that were discussed.

On Friday afternoon occurred the first Sedgwick Memorial Lecture under the auspices of the department of biology and public health of the Massachusetts Institute of Technology. The Sedgwick lectureship has been established to commemorate the services of the late Professor Sedgwick to the cause of biology and public health. These lectures are to be given from year to year by men of distinguished eminence in the several subjects comprehended within the general scope of biology and public health, in order that there may be fittingly expressed the deep and broad sympathy that characterized the man whom the lectureship is designed to honor.

The lecture this year was delivered by Dr. Edmund B. Wilson, Da Costa professor of zoology in Columbia University, who spoke on "The physical basis of life." In this address illustrated by lantern slides, Dr. Wilson reviewed some of the problems of protoplasm and the cell from the standpoint of the modern cytologist, embryologist and geneticist, comparing present views with those expressed by Huxley in his Edinburgh address fifty years ago. The speaker showed how the problems of the cytologist merge into those of the colloid chemist and the biochemist, and how from either point of view the cell appears as a complex, definitely organized system. The cytologist and the biochemist alike are driven to the assumption of a definite organization in the apparently structureless ground substance or hyaloplasm that forms the fundamental basis of the cell system. Reasons were given for the conclusion that this substance consists of innumerable ultra-microscopic dispersed bodies of all orders of magnitude—many of them self-perpetuating, and forming the foci for visible formed elements of the cell system. Many facts point to the conclusion that both the visible and the invisible components of the system are segregated and distributed by definitely ordered processes in cell-division and heredity. Life is a property of the system as such, and the problem of its physical basis is inseparable from the problem of the organization of the system; but we still have no more than a rudimentary understanding of what this organization is. There is, however, no reason to despair of solving this problem by mechanistic methods—by observation and experiment; vitalistic conceptions lead us merely to abandon hope of progress.

The fifth, and last, general session was held on Friday evening, December 29, this being a special session of Section M (Engineering). The speaker on this occasion was Mr. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, who delivered a very interesting and stimulating illustrated lecture on "Engineering and scientific developments in South America." Mr. Rice dealt mainly with his experiences in South American countries during a recent trip in which he attended the International Engineering Congress as the official delegate of many engineering societies of the United States and Canada. It was pointed out that South American civilization is in many respects very excellent indeed, and is not nearly always to be regarded as inferior to our own. Displaying some South American newspapers with first pages altogether devoted to world news rather than to the crime stories that are so conspicuous in our daily press, he urged that English-speaking Americans should follow South American example and take greater interest in world affairs. Turning to the status of engineering in South America, Mr. Rice emphasized the point that engineers are there generally regarded as representing the highest type of citizen. South American engineers are now well organized, owing mainly to the activities of Mr. Rice. Every South American country now has its engineering organization, and these organizations are interrelated so as to constitute a world fraternity giving service to all who are engaged in the engineering profession. They cooperate with engineering societies in the northern division of the continent.

THE COUNCIL ROLL AT BOSTON

The affairs of the association are wholly in the charge of the council, which consists of the president, the vice-presidents, the treasurer, the secretaries, the council representatives of the affiliated societies and academies and eight members elected by the council itself. The list of council members for the seventy-sixth meeting is shown below, arranged according to this classification. The attendance at the four Boston sessions is shown by the numerals that precede members' names, the four numerals corresponding to the four sessions, on Tuesday, Wednesday, Thursday and Friday, respectively. Thus, the numbers 2, 4 before a name indicate that the member so marked was present at the Wednesday and Friday sessions of the council.

Every council member receives an official notice, calling his attention to his responsibility, just before each annual meeting, with the urgent request that he attend the council sessions and take part in the direction of the affairs of the association. It is greatly to be deplored that not more of the members seem to realize the importance of their responsibilities to the cause for which our association stands, that not more of them make it a point to attend the council sessions. A very small number of the absentees this year presented reasons for their absence, or arranged for representatives to take their places. It is very gratifying, however, to note that, out of the 126 members of the council, there were but 64 that did not appear at all at the Boston sessions. On Tuesday 29 were present; on Wednesday, 32; on Thursday, 22; on Friday, 37. It is noteworthy that the secretaries, who receive from the association a mileage allowance for their trips to the annual meetings, show attendance records above the average. There are seventeen of these, and five of them attended all of the Boston sessions. Many of the representatives of the affiliated societies and academies this year failed to be present at any of the council sessions. Perhaps it needs to be emphasized that these representatives bear important responsibilities to their societies and to the association as a whole. The council holds sessions only at the annual meetings of the association, and the democratic nature of our organization renders it very important indeed that attendance at these sessions should be as complete as possible.

MEMBERS OF THE COUNCIL FOR THE FOURTH BOSTON MEETING

(Ex-Officio Members)

The President:

1, 2, 4 J. Playfair McMurrich, University of Toronto.

The Vice-Presidents for the Sections:

4 G. A. Miller (A), University of Illinois.
1, 2, 4 F. A. Saunders (B), Harvard University.
W. Lash Miller (C), University of Toronto.
Otto Klotz (D), Ottawa, Canada.
1 H. W. Shimer (E), Massachusetts Institute of Technology.
1 M. M. Metcalf (F), Oberlin College.
1, 2, 4 F. E. Lloyd (G), McGill University.
3, 4 T. Wingate Todd (H), Western Reserve University.
4 Raymond Dodge (I), Wesleyan University.
2 Henry S. Graves (K), Yale University.
Wm. A. Locy (L), Northwestern University.
F. M. Feiker (M), New York City.
Francis W. Peabody (N), Boston City Hospital.
R. W. Thatcher (O), New York Agricultural Experiment Station.
Bird T. Baldwin (Q), University of Iowa.

The Permanent Secretary:

1, 2, 3, 4 Burton E. Livingston, Johns Hopkins University.

The General Secretary:

1, 2, 3, 4 D. T. MacDougal, Desert Laboratory.

The Treasurer:

R. S. Woodward, Carnegie Institution of Washington.

The Secretaries of the Sections:

1, 2, 3, 4 Wm. H. Roever (A), Washington University.
1, 4 Otto Koppius (B; acting for S. R. Williams), Oberlin College.
1, 3, 4 W. D. Harkins (C), University of Chicago.
3 F. R. Moulton (D), University of Chicago.
1, 2, 3, 4 Elwood S. Moore (E), University of Toronto.
4 H. W. Rand (F), Harvard University.
1, 2, 3, 4 Robert B. Wylie (G), University of Iowa.
1, 3 E. A. Hooton (H), Peabody Museum, Cambridge, Mass.
2, 4 Frank N. Freeman (I), University of Chicago.
1 Frederick L. Hoffman (K), Babson Institute.
2, 4 Frederick E. Brasch (L), Rogers Park, Chicago.
L. W. Wallace (M), Washington, D. C.
1, 4 A. J. Goldfarb (N), College of the City of New York.
3, 4 P. E. Brown (O), Iowa State College.
1 A. S. Barr (Q), Detroit, Mich.

MEMBERS REPRESENTING AFFILIATED SOCIETIES

The Representatives of the American Mathematical Society:

1 O. D. Kellogg, Harvard University.
1 R. G. D. Richardson, Brown University.

The Representatives of the Mathematical Association of America:

2, 3 W. D. Cairns, Oberlin College.
2 H. L. Rietz, University of Iowa.

The Representatives of the American Physical Society:

Theodore Lyman, Harvard University.
Dayton C. Miller, Case School of Applied Science.

The Representative of the American Meteorological Society:

1, 2, 3, 4 W. J. Humphreys, U. S. Weather Bureau.

The Representative of the Optical Society of America:

1 F. K. Richtmyer, Cornell University.

The Representatives of the American Chemical Society:

Charles L. Parsons, Washington, D. C.
Edgar F. Smith, University of Pennsylvania.

The Representatives of the American Astronomical Society:

1 Louis Bell, West Newton, Mass.
1, 2, 4 John C. Duncan, Whitin Observatory.

The Representatives of the Geological Society of America:

E. O. Hovey, American Museum of Natural History.
Charles Schuchert, Yale University.

The Representatives of the Association of American Geographers:

Richard E. Dodge, Connecticut Agricultural College.
1 Robert DeC. Ward, Harvard University.

The Representatives of the Seismological Society of America:

H. F. Reid, Johns Hopkins University.
1, 2 S. D. Townley, Stanford University.

The Representative of the American Geographical Society of New York:

Isaiah Bowman, New York City.

The Representatives of the American Society of Zoologists:

H. E. Crampton, Columbia University.
Charles Zeleny, University of Illinois.

The Representatives of the Entomological Society of America:

Arthur Gibson, Ottawa, Canada.
2, 4 C. L. Metcalf, University of Illinois.

The Representatives of the American Association of Economic Entomologists:

2, 4 T. J. Headlee, New Jersey Agricultural Experiment Station.
1, 2, 3, 4 L. O. Howard, U. S. Department of Agriculture.

The Representative of the Eugenics Research Association:

Harry H. Laughlin, Cold Spring Harbor, N. Y.

The Representative of the American Society of Mammalogists:

2, 4 Hartley H. T. Jackson, U. S. Biological Survey.

The Representatives of the Botanical Society of America:

C. E. Allen, University of Wisconsin.
J. R. Schramm, National Research Council.

The Representatives of the American Phytopathological Society:

4 Mel. T. Cook, New Jersey Agricultural Experiment Station.
C. L. Shear, U. S. Department of Agriculture.

The Representatives of the American Society of Naturalists:

2, 3 John H. Gerould, Dartmouth College.
J. Arthur Harris, Cold Spring Harbor, N. Y.

The Representatives of the Ecological Society of America:

Stephen A. Forbes, University of Illinois.
Edgar N. Transeau, Ohio State University.

The Representatives of the American Genetic Association:

A. F. Blakeslee, Cold Spring Harbor, N. Y.
4. E. N. Wentworth, Armour's Bureau of Agriculture, Research and Economics.

The Representative of the American Microscopical Society:

Paul S. Welch, University of Michigan.

The Representatives of the American Anthropological Association:

J. Walter Fewkes, Smithsonian Institution.
2, 3, 4 Clark Wissler, American Museum of Natural History.

The Representatives of the American Psychological Association:

Edwin G. Boring, Harvard University.
Edward A. Bott, University of Toronto.

The Representatives of the American Society of Mechanical Engineers:

Ira N. Hollis, Worcester Polytechnic Institute.
Dugald C. Jackson, Massachusetts Institute of Technology.

The Representatives of the American Institute of Electrical Engineers:

2, 4 A. E. Kennelly, Harvard University.
4 John B. Taylor, Schenectady, N. Y.

The Representatives of the American Institute of Mining and Metallurgical Engineers:

Waldemar Lindgren, Massachusetts Institute of Technology.
1, 2, 3, 4 J. B. Tyrrell, Toronto, Canada.

The Representatives of the American Society of Civil Engineers:

John R. Freeman, Providence, R. I.
George C. Whipple, Harvard University.

The Representatives of the Illuminating Engineering Society:

Ernest Fox Nichols, Nela Research Laboratory.
Clayton H. Sharp, White Plains, N. Y.

The Representative of the American Society for Testing Materials:

C. L. Warwick, Philadelphia, Pa.

The Representatives of the American Medical Association:

Geo. H. Simmons, Chicago, Ill.
Geo. M. Kober, Washington, D. C.

The Representative of the American Association of Anatomists:

Simon H. Gage, Cornell University.

The Representative of the Society of American Bacteriologists:

E. O. Jordan, University of Chicago.

The Representative of the American Society of Agronomy:

3, 4 W. L. Slate (representing C. A. Mooers, University of Tennessee).

The Representative of the Society of American Foresters:

Gifford Pinchot, Milford, Pa.

The Representative of the American Society for Horticultural Science:

1, 2, 4 J. K. Shaw, Massachusetts Agricultural Experiment Station.

The Representative of the Canadian Society of Technical Agriculturists:

W. H. Brittain, Truro, N. S., Canada.

The Representatives of the National Society of College Teachers of Education:

Arthur J. Jones, University of Pennsylvania.

John W. Withers, New York University.

The Representatives of the National Society for the Study of Education:

Ernest Horn, University of Iowa.

1 Guy M. Whipple, University of Michigan.

The Representative of the American Federation of Teachers of the Mathematical and Natural Sciences:

William A. Hedrick, Washington, D. C.

The Representative of the Southern Education Society:

J. P. McConnell, East Radford, Va.

The Representatives of the Society of Sigma Xi:

2 C. E. McClung, University of Pennsylvania.

1, 2 Edward Ellery, Union College.

The Representative of the American Association of University Professors:

J. M. Coulter, University of Chicago.

The Representatives of the Gamma Alpha Graduate Scientific Fraternity:

L. I. Knight, University of Minnesota.

2 H. L. Rietz, University of Iowa.

The Representative of the Illinois State Academy of Science:

Charles T. Knipp, University of Illinois.

The Representative of the Iowa Academy of Science:

2 Geo. W. Stewart, University of Iowa.

The Representative of the Kansas Academy of Science:

O. P. Dellinger, Pittsburgh, Kans.

The Representative of the Kentucky Academy of Science:

A. M. Peter, Kentucky Experiment Station.

The Representative of the Maryland Academy of Sciences:

Arthur B. Bibbins, Baltimore, Md.

The Representative of the Michigan Academy of Science, Arts and Letters:

E. C. Case, University of Michigan.

The Representative of the Nebraska Academy of Sciences:

J. C. Jensen, Wesleyan University.

The Representative of the New Orleans Academy of Science:

H. W. Moseley, Tulane University.

The Representative of the North Carolina Academy of Science:

4 Z. P. Metcalf, North Carolina College of Agriculture and Engineering.

The Representative of the Ohio Academy of Science:

2, 3, 4 E. L. Rice, Ohio Wesleyan University.

The Representative of the Oklahoma Academy of Science:

L. B. Nice, University of Oklahoma.

The Representative of the Wisconsin Academy of Sciences, Arts and Letters:

3 E. M. Gilbert (representing Chancey Juday, University of Wisconsin).

ELECTED MEMBERS OF THE COUNCIL

1, 2, 3, 4 J. McKeen Cattell, Garrison-on-Hudson, N. Y.

4 F. G. Cottrell, American University.

H. C. Cowles, University of Chicago.

2, 4 A. E. Douglass, University of Arizona.

4 John C. Merriam, Carnegie Institution of Washington.

4 G. A. Miller, University of Illinois.

W. E. Ritter, Scripps Institution.

1, 2, 3, 4 Henry B. Ward, University of Illinois.

PROCEEDINGS OF THE COUNCIL AND EXECUTIVE COMMITTEE AT BOSTON

The executive committee of the council met in the grill room of the Hotel Somerset at 10 a. m., on Tuesday, December 26, and the council met at 2 p. m. on the same day in the council room, Pratt Memorial Building, Massachusetts Institute of Technology. Later sessions of the council occurred in the same place at 9 o'clock on Wednesday, Thursday and Friday, and each of these later council sessions was followed by a session of the executive committee. Following is a summary of the business transacted:

(1) It was reported to the executive committee that the committee had authorized, by a mail ballot, a contribution of $100 to the American Institute of Sacred Literature, to aid in the dissemination by the institute of literature on the status of the theory of evolution. It was also reported that this contribution had been duly made.

(2) The executive committee voted that if any one of its members shall have been absent for two consecutive meetings, such action shall be regarded as a resignation and shall come before the committee for action. This was a reaffirmation of a similar rule that was in force in the old committee on policy, before the adoption of the present constitution.

(3) The treasurer's audited financial report for the period from December 20, 1921, to September 30, 1922—thus bringing the treasurer's year into conformity with the association year—was accepted by the council and ordered printed in SCIENCE.

(4) A statement showing receipts and disbursements for the entire period of the treasurer's incumbency, from August 21, 1894, to September

30, 1922, was accepted by the council and ordered printed in SCIENCE.

(5) The permanent secretary's audited annual financial report for the fiscal year 1922 (from October 1, 1921, to September 30, 1922) was accepted by the council and ordered printed in SCIENCE.

(6) The permanent secretary's budget for the fiscal year 1923 was approved by the council.

(7) It was reported by the general secretary that a large majority of the members of the association residing in Colorado desired to have that state included in the area of the Southwestern Division. The council therefore amended Article VI, Section 3, of the by-laws to that effect by inserting the word *Colorado* after the word *New Mexico.*

(8) It was voted by the executive committee that a message of greeting should be sent to the treasurer, Dr. Woodward, who was unable to be present at the meeting.

(9) A report from the special committee on the status of the evolution theory (E. G. Conklin, *chairman,* Henry F. Osborn and C. B. Davenport) was accepted by the council, and a set of resolutions recommended by that committee were adopted.

(10) The special committee on cooperation with Organizations of Mexican Men of Science (L. O. Howard, *chairman*) presented a report of progress, which was accepted by the council.

(11) A report of the special committee on Convocation Week (J. McKeen Cattell, *chairman*), which had been approved by the executive committee at its fall meeting, 1922, and which had been published in SCIENCE for December 1, 1922, was accepted by the council and the six resolutions therein recommended (on future meetings of the association) were adopted, the council voting separately on each resolution.

(12) It was voted by the council that the summer meeting for 1923 be held at the University of Southern California, Los Angeles, in conjunction with the Pacific Division and the Southwestern Division, this meeting to occur at a time in September, 1923, to be decided upon by the executive committee.

(13) The executive committee instructed the permanent secretary to send a communication to the British Association for the Advancement of Science, expressing the gratification of the American association that the British association is to meet in Toronto in the summer of 1924.

(14) The council elected two members to emeritus life membership, on the Jane M. Smith Foundation, the new life members being Dr. T. C. Chamberlin and Dr. Harvey W. Wiley.

(15) Eighty members of the association were elected to fellowship, distributed among the sections as follows: Section B, 3; Section C, 1; Section E, 5; Section F, 2; Section G, 44; Section I, 6; Section L, 2; Section N, 12; Section O, 5.

(16) A communication was presented to the executive committee by Mr. S. A. Moss, of the General Electric Company, Lynn, Mass., requesting the association to appoint representatives in the American Committee on the Standardization of Mathematical Symbols used in Engineering, etc. The appointment of three members was authorized, these to be named later by President McMurrich.

(17) The question of places of future meetings of the association was referred by the executive committee to a special committee, consisting of the general secretary, the permanent secretary and J. McKeen Cattell, with instructions to report at the spring meeting of the executive committee.

(18) The executive committee expressed its approval of the general aims of the newly organized Sigma Delta Epsilon Graduate Women's Scientific Fraternity, with the hope that the fraternity may be admitted to association with the American Association for the Advancement of Science at a later time, when it shall have become more thoroughly established.

(19) In response to a communication from the chairman of the Committee on Bibliography (Dr. C. B. Davenport), the executive committee adopted the following resolution: *Resolved,* That the executive committee regards it as desirable that a committee on bibliography be maintained in the American Association for the Advancement of Science, and requests the chairman of the present committee on that subject to consult with the members of his committee regarding possible work still to be accomplished for the association by such a committee, and to report subsequently on this matter to the executive committee.

(20) In response to a communication from the League of Nations, the council adopted a resolution expressing its sincere interest in the restoration of the University of Vienna to its former high rank and in the rehabilitation of Austrian scientific work in general.

(21) The executive committee considered a communication from the General Federation of Women's Clubs, dealing with the need of more and better nature study in American schools, and referred this to the section committee of Section Q, with the request that the section committee make recommendations to the executive committee in this regard.

(22) The executive committee authorized the

appointment, by the chair, of a special committee to consider the need of more and better American reviews of scientific publications, with the request that the special committee make recommendations to the executive committee in this regard. President McMurrich appointed the following three members of the special committee just mentioned, with the provision that these three shall appoint two more members, thus giving the committee a membership of five. The three members appointed are: W. J. Humphreys, *chairman*, D. T. MacDougal and J. McKeen Cattell. This committee is to appoint the two additional members.

(23) The executive committee authorized the permanent and general secretaries to make arrangements by which the preliminary announcements of association meetings may be distributed as second-class mail matter.

(24) In response to a communication from H. A. Spoehr, W. T. Bovie and Edwin E. Slosson, the executive committee authorized the formation of a special committee to survey the field of photosynthesis and to arrange for the cooperation of workers in fields related to this subject, with the aim of accelerating the advance of our knowledge of the photosynthetic process. It was voted that the formation of this committee be placed in the charge of the general secretary.

(25) The council appropriated the sum of $4,000 for grants in aid of research, for the fiscal year 1923, these moneys to be disbursed by the treasurer from the appropriable funds in his hands, according to allotments to be made by the committee on grants.

(26) The council voted that the president appoint a special committee of five to consider the question of the organization of work in the philological sciences in connection with the association, this committee to be announced at the spring meeting of the executive committee. Professor Mark H. Liddell, of Purdue University, was designated as secretary *pro tem* of the special committee.

(27) The council accepted a report presented by the committee on Reciprocity in Science between Canada and the United States, and the two resolutions recommended by the committee were adopted.

(28) The council adopted a resolution favoring the use of the metric system of weights and measures in the United States, and urging scientific men to employ metric units in all their publications, either exclusively or else with the customary non-metric units in parentheses.

(29) At the council session on Thursday, December 28, it was voted that Henry B. Ward and Herbert Osborn should serve as representatives of the council to attend the meetings of the American Society of Naturalists and the American Society of Zoologists, on Friday morning, these representatives being instructed to take part in the consideration of the proposed union of American biological societies.

(30) The council again expressed the desire of the association to cooperate in all feasible ways in the plans for a union of American biological societies, and affirmed its willingness to join in the particular plan proposed, provided (*a*) that the societies originally invited do so, and (*b*) that the expense to the association does not exceed $200 for the first year.

(31) The council accepted and adopted a report of the special committee on United States Copyright Laws (Clement W. Andrews, *chairman*), approving the main purpose of H. R. Bill 11476, now before the U. S. Congress, but strongly urging the elimination of Section 6, or the limitation of its application to importations in bulk.

(32) A resolution on Indian lands in the United States was considered by the council and was referred to the executive committee with power.

(33) A resolution concerning geological features of city parks was considered by the council and was referred to a special committee, to be appointed by the president, with the recommendation that the resolution be made to include all natural features in city parks. The special committee is to make recommendations to the executive committee in this regard. Its members have not yet been named.

(34) By a unanimous vote of the council, Charles D. Walcott, secretary of the Smithsonian Institution, was elected president of the association for the calendar year 1923.

(35) The following vice-presidents of the association were elected by the council, for the calendar year 1923:

For Section A (Mathematics), Harris Hancock, professor of mathematics, University of Cincinnati.

For Section B (Physics), W. F. G. Swann, professor of physics, University of Chicago.

For Section C (Chemistry), E. W. Washburn, chairman of Division of Chemistry and Chemical Technology, and editor-in-chief of *International Critical Tables;* National Research Council, Washington, D. C.

For Section E (Geology and Geography), N. M. Fenneman, professor of geology and geography, University of Cincinnati.

For Section F (Zoological Sciences), E. L.

Rice, professor of zoology on the Cincinnati Conference Foundation, Ohio Wesleyan University, Delaware.

For Section G (Botanical Sciences), Charles J. Chamberlain, professor of morphology and cytology, Department of Botany, University of Chicago.

For Section H (Anthropology), E. A. Hooton, assistant professor of anthropology, Harvard University, and curator of somatology, Peabody Museum of Archæology and Ethnology, Cambridge, Massachusetts.

For Section I (Psychology), Raymond Dodge, professor of psychology, Wesleyan University, Middletown, Connecticut.

For Section K (Social and Economic Sciences), John F. Crowell, economist, 30 Church Street, New York City.

For Section O (Agriculture), R. A. Pearson, president, Iowa State College, Ames.

(36) The council referred to the executive committee, with power, the election of vice-presidents for the sections D, L, M, N and Q, from which sections vice-presidential nominations were not yet at hand.

(37) The following section secretaries were elected by the council, for the remainder of the four-year term ending at the close of the next Washington meeting (December, 1924):

Section C (Chemistry), W. D. Harkins, professor of chemistry, University of Chicago.

Section H (anthropology), R. J. Terry, professor of anatomy, Washington University School of Medicine, St. Louis, Missouri.

Section Q (Education), A. S. Barr, assistant director in charge of instruction, Board of Education, Detroit, Michigan.

(38) The following council members were elected by the council, for terms expiring at the end of the calendar year 1926:

H. L. Fairchild, emeritus professor of geology, University of Rochester.

G. A. Miller, professor of mathematics, University of Illinois, Urbana.

(39) The following members of the executive committee were elected by the council, for terms expiring at the end of the calendar year 1926:

J. McK. Cattell, editor of Science, Garrison-on-Hudson, N. Y.

Henry B. Ward, professor of zoology, University of Illinois, Urbana.

(40) The council elected the following members of the Committee on Grants for Research, for terms expiring at the end of the calendar year 1926:

W. D. Harkins (for chemistry), professor of chemistry, University of Chicago.

Frank Schlesinger (for mathematics and astronomy), director, Yale University Observatory, New Haven, Connecticut.

(41) The council gave a rising vote of thanks to Dr. J. Playfair McMurrich, for the fine and tactful efficiency with which he had served as chairman of the council during the Boston meeting.

(42) The council instructed the permanent secretary to write letters of appreciative thanks to the local committee for this meeting, to the Massachusetts Institute of Technology and Harvard University, to the Mayors of Boston and Cambridge, and to Messrs. Ginn and Company for the parts they have taken in making the fourth Boston meeting a success.

FINANCIAL REPORTS

The annual report of the treasurer of the association, to September 30, 1922, will be published in a later issue of Science. The total of the permanent funds now amounts to $121,414.77. The appropriable income from this endowment was $5,812.52 for the calendar year 1922. Of this, $4,000 was appropriated at the Boston meeting, for grants, and $200 for emeritus life memberships.

The permanent secretary's financial report for the fiscal year 1922 shows a total of $69,390.21, representing receipts from all sources, including balances from the preceding year, and the item of total expenditures is shown as $62,314.13, including $5,430.43 paid on account of the publication of the last volume of proceedings. The last mentioned item is not properly chargeable to the current expenses of 1922, for it represents the years 1915 to 1921. At the beginning of the year 1922 the emergency fund amounted to $4,355.09 and it contained $5,997.68 at the end of the year. The current balance at the end of 1922, not including emergency fund, amounted to $1,078.40. This report will be published in a later issue of Science.

The permanent secretary's budget of prospective expenditures during the fiscal year 1923 amounts to $56,158.00. The items of the budget will be published later in Science.

FELLOWSHIP ELECTIONS

The by-laws of the association state: "All members who are professionally engaged in scientific work, or who have advanced science by research, may be elected by the council to be fellows on nomination or on their own application. "This qualification is understood to have been met by members of affiliated societies having a research qualification."—*Article II, Section* 4. Certain officers of the association must be elected from among the fellows.

Each newly elected fellow receives a notification of election and a certificate of fellowship. In the published membership lists the name of each fellow is preceded by an asterisk. On the addressograph plates used by the permanent secretary's office in addressing members there always occurs a membership symbol showing the years of the member's election to membership, to fellowship and to life membership. The formula 17F19L20, for example, denotes membership since 1917, fellowship since 1919, life membership since 1920. If a fellow allows his membership to lapse, or if he resigns, and is subsequently elected to membership as a new member, he is automatically entered in the lists as a fellow on the basis of his first election. It therefore sometimes occurs that a membership symbol shows an earlier year for fellowship than for membership. Fellows should not allow their membership to be discontinuous, however; a long, unbroken record in the association may well be considered as a legitimate subject for some personal pride. Fellows are asked to inform the permanent secretary promptly regarding any errors that may occur in the membership symbols on their addressograph plates.

Nominations for fellowship are made on special fellowship nomination blanks, which may be secured from any section secretary or from the permanent secretary's office. Nominations may be sent in to the proper section secretary or to the permanent secretary at any time. They are first referred to the secretary of the proper section, who, after investigation, makes recommendation to the executive committee in each case. Cases in which a nomination is not approved by the section secretary may be referred by the executive committee to the Committee for Reference on Fellowship Nominations, which, after investigation, makes recommendation to the executive committee. The executive committee makes elections to fellowship at its spring and fall meetings. At the annual meeting of the association the executive committee makes recommendation to the council regarding fellowship nominations to be acted upon at that time. Consequently, for each fiscal year there are generally three lists of fellowship elections, one for the fall meeting of the executive committee, one for the annual meeting of the council and one for the spring meeting of the executive committee.

It seems desirable that the matter of fellowship be given very serious attention, and it is hoped that all members will cooperate with the secretaries to the end that every one who is eligible to fellowship shall be nominated. Beginning with the fiscal year 1923, it is planned that the names and addresses of all newly elected fellows shall be published in SCIENCE.

RESOLUTIONS ADOPTED BY THE COUNCIL

A STATEMENT ON THE PRESENT SCIENTIFIC STATUS ON THE THEORY OF EVOLUTION

Inasmuch as the attempt has been made in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

SINCE it has been asserted that there is not a fact in the universe in support of this theory, that it is a "mere guess" which leading scientists are now abandoning, and that even the American Association for the Advancement of Science at its last meeting in Toronto, Canada, approved this revolt against evolution, and

Inasmuch as such statements have been given wide publicity through the press and are misleading public opinion on this subject,

Therefore, the council of the American Association for the Advancement of Science has thought it advisable to take formal action upon this matter, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 11,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution.

(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a "mere guess." No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in

the world, and that these evidences are increasing in number and importance every year.

(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress.

A RESOLUTION REGARDING THE DESIRABILITY OF THE METRIC SYSTEM OF WEIGHTS AND MEASURES FOR THE UNITED STATES

Whereas, The metric system of weights and measures has not yet been brought into general use in the United States, and

Whereas, The American Association for the Advancement of Science has already adopted and published resolutions favoring the adoption of the metric system of weights and measures in the United States; therefore be it

Resolved, That the American Association for the Advancement of Science reaffirms its belief in the desirability of the adoption of the metric system of weights and measures for the United States, and recommends that the units of that system be used by scientific men in all their publications, either exclusively or else with the customary non-metric units in parentheses.

RESOLUTIONS ON THE INTERNATIONAL SCIENTIFIC RELATIONS BETWEEN CANADA AND THE UNITED STATES

Presented by the Committee on Reciprocity in Science between Canada and the United States.

I. Resolution on Marine Mammals

In view of the fact that the American Association for the Advancement of Science is international in its scope and interests,

The council of the association recommends that the National Academy, the National Research Council, the Royal Society of Canada and the Honorary Council for Scientific and Industrial Research be requested to exert their influence in inducing the governments concerned to consider the advisability of taking such steps as may be necessary for the better conservation of marine mammals and the further study of their life histories.

II. Resolutions on the Complete Conservation of Certain Areas

Whereas, The American Association for the Advancement of Science has a special committee on reciprocity in science between Canada and the United States, and

Whereas, The committee just mentioned has made a study of the problem of the preservation of floral and faunal areas in North America, and has recommended the following resolutions to the association; therefore, be it

Resolved, That the council, acting for the association, heartily supports the plan for complete conservation of certain areas, especially those which contain peculiarly interesting representations of floras and faunas and natural features of special interest in the educational sense, or subjects which may be desired for the conduct of future researches. And, be it further

Resolved, That the definition of this principle is not to be confused with commitment in support of specific areas without careful study of all factors, including those which relate to the proper balance between conservation and utilization.

A STATEMENT REGARDING PROPOSED COPYRIGHT LEGISLATION IN THE UNITED STATES

There has been introduced in the present United States Congress a bill (H. R. 11476) which has for its main purpose the removal of the present restriction of copyright in the United States to books printed in this country. The removal of this restriction would give authors, foreign as well as American, the protection which all important civilized nations except the United States, Russia and Mexico now give through the Berne Convention. The association heartily approves this action and endorses those provisions of the bill which secure it.

Unfortunately, however, the bill contains a section which has an entirely different purpose. Section 6 in its original form provided that, with a few exceptions of no importance in the present discussion, no copies of the original edition could be imported by any one except through the holder of the American rights. It is understood that this section was inserted at the instance of certain publishing houses and as the price of their support of the bill. In the opinion of the council of the association, after thorough inquiry and study by a special committee of the association, this is a most serious menace to American scholarship and to the American reading public. Although it is not probable that this bill will be acted upon during the present session of the Congress, yet the importance of the subject and of the interests affected make it desirable that the association shall consider and record their opinion of certain of its provisions.

The section mentioned applies to books by a foreign author published in this country under assignment of the United States Copyright, but it makes no definition of what constitutes "publication." This means that any importing house can, by *merely having its name put on the title-page* of a small number of copies, completely control the importation of the work and fix the American price without competition. In its original form, this provision applied to all copies of all books so protected, but after a conference between representatives of the publishers and of the libraries, a substitute section has been introduced, which exempts books in foreign languages and secondhand copies. Even when thus limited, the provision would cause very great damage to the interests of individual scholars and to educational institutions and would be contrary to the provision of the Constitution of the United States which gives Congress power to enact copyright legislation "to promote the progress of science and useful arts."

There are three important reasons why the council of the association wishes to be recorded as strongly objecting to the provisions of the substitute section just considered. These reasons are as follows:

First, There is no requirement of simultaneous publication, and, even if importations could be made before the exclusion of original copies became effective, it is evident that there could be no certainty as to the time available and no assurance that copies ordered in perfect good faith would not be confiscated on arrival. Moreover, the existence of an American edition would have to be determined for each particular case—a serious burden on individual scholars, an almost intolerable one on educational institutions, and, it may be supposed, an almost intolerable one on the United States Treasury officials.

Second, The bill recognizes the fact that the original edition may be more desirable than the American one and provides a means of obtaining the former through the holder of the American copyright, or independently if he refuses to agree to supply, yet it fails to specify any time limit within which the agreement must be carried out. Here, also, it is evident that the proposed provisions would cause serious delay, much correspondence and many formalities.

Third, There is nothing in the bill about the price at which the original edition would be supplied. What that omission would result in is evident from the present practice of certain American representatives of English houses whose American prices for books not so protected is out of all proportion to the corresponding English prices.

In conclusion, the council of the association heartily approves the main purpose of the bill here considered, but urges most strongly the elimination of Section 6, or the limitation of its application to bulk importations that would compete with the American edition in the open market; and the council directs that this statement of its position be communicated to the proper congressional committees whenever the bill shall be taken under consideration.

RESOLUTION ON THE STATUS OF AUSTRIAN SCIENCE

Resolved, That, in reply to the communication from the Committee on Intellectual Co-operation, of the League of Nations, the Council of the American Association for the Advancement of Science expresses its sincere interest in the restoration of the University of Vienna to its former high rank among the universities of the world, and recommends that the association and American men of science cooperate in all possible ways with the Austrian men of science in promoting their scientific work.

RESOLUTIONS ON THE PLANNING OF FUTURE MEETINGS OF THE ASSOCIATION

1. *Resolved,* That the greater convocation-week meetings of the American Association for the Advancement of Science and the affiliated national scientific societies be continued as for the past twenty years at four-year periods in succession in Washington, New York and Chicago, and that all national scientific societies be invited and urged to join in these meetings.

2. *Resolved,* That a corresponding twelve-year cycle of meetings for the intervening two-year periods be arranged for large cities in succession in the New England, the Central and the Atlantic states, in which it is desirable that the national scientific societies join.

3. *Resolved,* That a provisional schedule of meetings in other cities for the odd years be arranged in advance, for the convenience of the scientific societies that may find it desirable to meet with the association.

4. *Resolved,* That arrangements be made for a summer meeting in 1923.

5. *Resolved,* That scientific councils, boards and committees can to advantage hold their meetings in Washington during the fourth week

of April, in New York at the end of Thanksgiving week, in Chicago on or about February 1, and in Woods Hole in August.

6. *Resolved*, That convocation-week be the week in which New-Year's day falls when this is Thursday, Friday or Saturday; that when New Year's day falls on Sunday, it be the preceding week; that when it falls on Monday, Tuesday or Wednesday, it begin two days after Christmas and continue into New Year's week.

Note.—According to the provisions of the sixth resolution, the dates of future annual meetings of the association for the fiscal years given are provisionally established as follows:

1924 (Cincinnati) — Thursday, December 27, 1923, to Wednesday, January 2, 1924.

1925 (Washington)—Monday, December 29, 1924, to Saturday, January 3, 1925.

1926 (Kansas City)—Monday, December 28, 1925, to Saturday, January 2, 1926.

1927 (———)--Monday, December 27. 1926, to Saturday, January 1, 1927.

1928 (———)--Monday, December 26, to Saturday, December 31, 1927.

1929 (New York)—Thursday, December 27, 1928, to Wednesday, January 2, 1929.

THE BOSTON SESSIONS OF SECTIONS AND SOCIETIES

INTRODUCTORY NOTE

AN attempt has been made this year to secure readable accounts of all of the section and society programs for publication in this special issue of the association journal. Several kinds of difficulty have been encountered, however, and it must be admitted that the following array of section and society reports leaves ample verge for future improvement in this aspect of our post-convention work. It is planned to follow, in coming years, the general plan now introduced for the first time, bringing together all the reports of each annual meeting in a special issue of SCIENCE, to appear in January as early as may be. Those who read the following accounts are therefore requested to consider ways and means by which more satisfactory reports may be secured at the close of the Cincinnati meeting a year hence. The permanent secretary will be glad to receive suggestions that may result in a more efficient cooperation of all concerned than has been possible this year.

Before the approach of the autumn period of hectic activities in association affairs, each section secretary was asked to cooperate to secure the needed reports at the close of the meeting. It was emphasized that each section secretary represents the association in its program relations with the societies in his own field that meet with the general organization, and section secretaries were asked to see to it that all of the societies in their respective groups were properly cared for with respect to the prospective preparation of the needed reports. The attention of society secretaries was subsequently called to our plans, and they were requested to cooperate with their section secretaries in this regard. After several other notifications and requests in this same direction all secretaries were asked to have reports of all their sessions ready for publication before leaving Boston. About five or six reports were actually in the permanent secretary's hands at the close of the meeting. Many additional reports were received between the close of the meeting and January 7, on which date a telegraphic request was sent to each secretary whose report had not already arrived. Our telegraph bill for January 7 was over sixteen dollars. The following series of reports had to be closed January 15, and we have included all the material on hand at that time.

The novelty of this plan is perhaps an important item in the explanation of the difficulties encountered. Although we all agree that the association should be greatly improved in its service to the societies and to its members and the public, yet conservatism (or just inertia) must be overcome whenever any marked improvement in our work is instituted. That things "always have been done" in a certain way is not infrequently encountered as a reason for persisting in a more or less unsatisfactory practice. We scientists are just human in this respect.

Besides the difficulty of novelty, we have had to cope with other kinds of difficulty. Some secretaries confessed their inability to prepare or get prepared, brief, readable reports on such heterogeneous series of topics as generally constitute a scientific program. It seemed to some that every paper read ought to be reported, which is clearly impossible as well as undesirable. Some wished to repeat the programs as published in the general program.

On the whole, however, it seems that the following reports represent a considerable achievement, and the permanent secretary and the assistant secretary wish to express their thanks to all who have contributed thereto. Besides serving their present purpose, this collection of reports may well be valuable as a starting point for better plans that may lead to the securing of still more satisfactory reports next year.

The reports are arranged below in the order of the sections to which they pertain (the letter-and-number symbols being the ones used in the general program. The letters correspond to the several sections of the association, and the several organizations are numbered serially in each letter group, beginning with the section organization itself.

Special attention is called to the following statement from the Boston Preliminary Announcement: The general program of the fourth Boston meeting may be obtained free by members in good standing if they will write to the permanent secretary and enclose five cents in stamps to pay postage. Requests for programs will be complied with as long as the supply lasts.

SECTION A—MATHEMATICS

Vice-president and chairman, G. A. Miller.

Retiring vice-president, Oswald Veblen.

Secretary, William H. Roever, Washington University, St. Louis, Mo.

(Report by William H. Roever)

The retiring presidential address for the association as a whole was this year devoted to a mathematical subject. Retiring President E. H. Moore delivered his address at the first general session on Tuesday evening, December 26, on the subject "What is a number system?"

The American Mathematical Society and the Mathematical Association of America met with the American Association. Besides several sessions of their own, which are reported below, there were two joint sessions with Section A.

On Wednesday, December 27, in Room 2-190 at the Massachusetts Institute of Technology, Section A of the American Association for the Advancement of Science and the American Mathematical Society held a symposium on "Space and time," at which three aspects of the subject were considered under the following titles: "The logic of space and time" by G. D. Birkhoff; "The physical meaning of space and time," by P. W. Bridgman; "The astronomical measures of space and time," by Harlow Shapley.

On Thursday afternoon, at Harvard University, Section A, with the American Mathematical Society and the Mathematical Association of America, held a joint session, at which addresses were given by representatives of these organizations. The titles of these addresses follow: "Reduction of singularities of plane curves by birational transformation," address of retiring president of the American Mathematical Society, G. A. Bliss, University of Chicago; "The grafting of the theory of limits on the calculus of Leibniz," by Florian Cajori, University of California (representing the Mathematical Association of America); "Geometry and physics," address of the retiring vice-president for Section A, American Association for the Advancement of Science, Oswald Veblen, Princeton University.

At a meeting of the Section Professor Harris Hancock, of the University of Cincinnati, was nominated for vice-president of the Section, to preside at the meeting in Cincinnati and to give his retiring address at the meeting in Washington. Professor W. A. Hurwitz, of Cornell University, was elected to membership on the Section committee, to serve for four years, taking the place of Professor G. A. Bliss, whose term expired with the Boston meeting. On Thursday evening, December 28, a joint dinner was given to all visiting mathematicians.

THE AMERICAN MATHEMATICAL SOCIETY

Chairman, G. A. Bliss.

Secretary, R. G. D. Richardson; Brown University, Providence, R. I.

(Report by R. G. D. Richardson)

The twenty-ninth annual meeting of the American Mathematical Society was held at Harvard University, Cambridge, on December 27 and 28, 1922. The attendance included one hundred and forty-five members of the society. It was announced that ten members of the London Mathematical Society had joined the society under the reciprocity agreement, and the election of twenty-two other members was announced.

The total membership in the society is now 1,100, including eighty-three life members. The treasurer's report shows expenditures of \$7,858.07 and cash receipts of \$10,486.21 during 1922; it is to be noted, however, that on account of the printing situation no numbers of the *Transactions* have been paid for during this year. The total number of volumes in the library is now 6,203.

At the annual election the following officers and other members of the council were elected: *President,* Professor Oswald Veblen; *vice-presidents,* Professors R. L. Moore and H. W. Tyler; *secretary,* Professor R. G. D. Richardson; *treasurer,* Professor W. B. Fite; *librarian,* R. C. Archibald; *committee of publication,* Professors E. R. Hedrick, W. A. Hurwitz and J. W. Young; *members of the council to serve until December, 1925,* Professors E. T. Bell, W. H. Bussey, J. C. Fields and Arthur Ranum.

It was decided to hold the summer meeting of 1923 at Vassar College and the annual meeting in New York City. Professors C. N. Moore and R. G. D. Richardson were appointed to represent the Society in the Council of the American Association for the Advancement of Science. Professor G. A. Bliss was appointed as *ad interim* representative on the American Section of the International Mathematical Union.

As noted above in the report of Section A, a joint session was held with that organization on Wednesday afternoon, and another with the Mathematical Association and Section A, on Thursday afternoon.

THE MATHEMATICAL ASSOCIATION OF AMERICA

President, R. C. Archibald.

Secretary, W. D. Cairns, Oberlin College, Oberlin, Ohio.

(Report by W. D. Cairns)

Following the joint session with Section A and the American Mathematical Society, the association held two sessions on Friday, December 29, 1922. The attendance at the sessions numbered 216, of whom 150 were members. The following officers for 1923 were elected or appointed:

President, Professor R. D. Carmichael, University of Illinois; *vice-presidents,* Chancellor A. B. Chace, Brown University, and Professor L. P. Eisenhart, Princeton University; *trustees,* Professor R. C. Archibald, Brown University, Professor C. F. Gummer, Queen's University, Professor Dunham Jackson, University of Minnesota, Professor E. H. Moore, University of Chicago, and Professor Clara E. Smith, Wellesley College; *secretary-treasurer,* Professor W. D. Cairns, Oberlin College; *librarian,* Professor L. C. Karpinski, University of Michigan.

Professor H. L. Rietz of the University of Iowa was appointed representative of the association in the Division of the Physical Sciences, National Research Council, for the three-year term beginning June 11, 1923. Twenty-seven persons and one institution were elected to membership.

The following papers were read at the Friday sessions, the afternoon session consisting of a symposium on "Mathematical statistics" with an extended discussion accompanying this: "Period of the bifilar pendulum for finite amplitudes," by H. S. Uhler; "Skew squares," by W. H. Echols; "On the averaging of grades," by C. F. Gummer; "Mathematics at Oxford and the Ph. D. degree," by W. R. Burwell; "Some unsolved problems in the theory of sampling," by B. H. Camp; "Some unsolved problems in solid geometry," by J. L. Coolidge; "The subject matter of a course in mathematical statistics," by H. L. Rietz; "Time series of economic statistics: their fluctuation and correlation," by Warren M. Persons; "Some fundamental concepts of the calculus of mass variation and their relations to practical problems," by Arne Fisher.

SECTION B—PHYSICS

Vice-president and chairman, F. A. Saunders.

Retiring Vice-president, G. W. Stewart.

Secretary, S. R. Williams.

Acting Secretary, Otto Koppius, Oberlin College, Oberlin, Ohio.

(Report by Otto Koppius)

Section B of the American association held its session on Thursday afternoon, December 28, at the Jefferson Physical Laboratory of Harvard University, Dr. F. A. Saunders presiding. The large lecture room of the laboratory was filled to its capacity.

Professor G. W. Stewart, of the State University of Iowa, the retiring vice-president for Section B, delivered his address on "Certain allurements in physics."[1] The allurements today are mainly in the following fields: Atomic structure and the theory of radiation, static *vs.*

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[1] See SCIENCE, Vol. LVII, pp. 1-6, 1923.

the orbit theory of the atom, Quantum theory. And yet, Professor Stewart pointed out, the older fields are not without their allurements; they may be less attractive, but the achievements are likely to be more permanent. The vice-presidential address was followed by a symposium on "Ionization potentials and atomic radiation," in which the following papers were read: "The interpretation of critical potentials," by K. T. Compton; "Atomic structure and spectroscopic consideration," by Paul D. Foote; "Ionization and astrophysics," by Henry Norris Russell.

At the business meeting of Section B, Dr. W. F. G. Swann, of the University of Minnesota, was nominated vice-president for the section for 1923, and Dr. A. H. Compton, of Washington University, St. Louis, Mo., was elected to be a member of the section committee, his term of office to end January 1, 1927.

THE AMERICAN PHYSICAL SOCIETY

President, Theodore Lyman.

Secretary, Dayton C. Miller; Case School of Applied Science, Cleveland, Ohio.

(Report by Dayton C. Miller)

The twenty-fourth annual meeting (one hundred and eighteenth regular meeting) of the American Physical Society was held in Cambridge, Massachusetts, on Wednesday, Thursday and Friday, December 27, 28 and 29, 1922. The sessions on Wednesday and Friday were held in Room 4-270 of the Massachusetts Institute of Technology, and the sessions of Thursday were held in the lecture room of the Jefferson Physical Laboratory of Harvard University. The presiding officers were Theodore Lyman and C. E. Mendenhall, president and vice-president of the society, respectively. On Thursday morning, there was a joint session with the American Astronomical Society. On Thursday afternoon, the annual joint session with Section B, American Association for the Advancement of Science, was held, Professor F. A. Saunders, chairman of Section B, presiding. The attendance of members and friends varied from two hundred to two hundred and fifty. On the evening of Friday, December 29, there was a dinner of members of the society and friends at the Harvard Union, attended by about two hundred persons. The arrangements made by the local committee for the entertainment of the members were most excellent, and the meeting was generally considered one of the most successful that the society has held. There were numerous receptions, exhibitions and excursions arranged in connection with the general program of the American Association for the Advancement of Science, which were taken advantage of, as far as possible, by the members of the society

The program of the Physical Society consisted of sixty-seven regular papers, three of which were read by title. Six papers from the program of the American Astronomical Society were presented at the joint session, and at the session with Section B there was an address by the retiring chairman entitled, "Certain allurements in physics." This was followed by a symposium on "Ionization potentials and atomic radiation," consisting of three addresses, as follows: "The Interpretation of critical potentials," by K. T. Compton, Princeton University; "Atomic structure from spectroscopic consideration," by Paul D. Foote, Bureau of Standards, and "Ionization and astrophysics," by Henry Norris Russell, Princeton University.

The regular annual business meeting of the American Physical Society was held on Friday morning, December 29, at 11 o'clock. A canvass of the ballots for officers resulted in elections as follows for the year 1923:

President: Charles E. Mendenhall, University of Wisconsin.

Vice-president: Dayton C. Miller, Case School of Applied Science.

Secretary: Harold W. Webb, Columbia University.

Treasurer: George B. Pegram, Columbia University.

Members of the council, four-year term: F. C. Brown, Bureau of Standards; A. Ll. Hughes, Queen's University.

Managing editor of the Physical Review, three-year term: G. S. Fulcher, Corning, N. Y.

Members of the board of editors of the Physical Review, three-year term: A. H. Compton, Washington University; E. H. Kennard, Cornell University; Leigh Page, Yale University.

THE AMERICAN METEOROLOGICAL SOCIETY

President, Sir Frederic Stupart.

Secretary, Charles F. Brooks; Clark University, Worcester, Mass.

(Report by Otto Koppius.)

Sessions were held at the Massachusetts Institute of Technology, beginning Friday morning, December 29, and continuing through Saturday. At the annual business meeting the society re-elected the retiring officers: *President*, Sir Frederic Stupart, 315 Bloom Street, Toronto, Canada; *vice-president*, W. J. Humphreys, U. S. Weather Bureau, Washington, D. C.; *secretary-treasurer*, Charles F. Brooks, Clark University, Worcester, Mass. The Friday afternoon session was featured with a symposium on "Anemometry," at which S. P. Ferguson and R. N. Covert, of the U. S. Weather Bureau, Washington, D. C., presented a paper on "The measurement of the wind." The other contribution was by Alexander McAdie, Harvard University, Blue Hill Observatory, Readville, Mass. He exhibited and explained the barometer and the thermometer used by Dr. John Jeffries in 1784 when he made the first crossing of the English Channel by air. S. P. Ferguson opened the discussion after the reading of these papers. On Saturday morning, December 30, Sir Frederic Stupart gave his presidential address on "Meteorological stations in high latitudes." A prolonged and active discussion by numerous members of the society followed the address, particularly in regard to extending the network of meteorological stations into the polar regions and over the oceans. The society considered itself fortunate to have had at its meetings the heads of the meteorological services of both the United States and Canada, as well as a former director of this service for Argentina. The feeling is that the sessions were extremely helpful and stimulating.

The consensus of opinion is that the Boston meetings were exceedingly interesting and inspiring, and all the sessions were well attended. The success of the meeting was largely due to the untiring work of the local committee, and to the cordiality and hospitality of the Massachusetts Institute of Technology and Harvard University. Both of these institutions were given votes of appreciation by societies associated with Section B.

SECTION C—CHEMISTRY

Vice-President and Chairman, W. Lash Miller.

Retiring vice-president, William D. Harkins.

Secretary pro tem., William D. Harkins, University of Chicago.

(Report by W. D. Harkins)

There were six well-attended sessions for chemistry at the Boston meeting, the first on Wednesday forenoon and the last on Friday forenoon, with two simultaneous sessions on Thursday afternoon. All but the two last-mentioned sessions were devoted to a continued symposium on the "Progress of chemistry," and the two exceptions might properly be considered as also belonging with the large symposium. One of the Thursday afternoon sessions was held jointly with Section G (Botanical Sciences) and the Physiological Section of the Botanical Society of America, with a symposium of invited papers on "Photosynthesis in plants and other aspects of photochemistry." The other Thursday afternoon session was a joint one with Section B (Physics) and the American Physical Society, with the retiring vice-presidential address for Section B (given by G. W. Stewart, State University of Iowa) followed by a symposium of invited papers, arranged by the physicists, on "Ionization potentials and atomic radiation."

The address of W. D. Harkins, retiring vice-president of Section C, was given on Wednesday afternoon, on "Atomic structure and the general system of isotopes." The symposium on "Photosynthesis in plants and other aspects of photochemistry" embraced the following titles: "Inventory of the world supply of energy," by E. E. Slosson, Science Service, Washington, D. C.; "Analysis of the mechanism of photosynthesis," by H. A. Spoehr, Carnegie Institution of Washington; "The nature of photochemical reactions," by W. T. Bovie, Harvard Medical School; "Photochemical reaction," by S. E. Sheppard, Eastman Kodak Company, and "Carbohydrate metabolism," by Charles O. Appleman, University of Maryland.

This symposium was very largely attended and the papers proved to be very valuable and inspiring. The very great importance of photosynthesis in plants was specially emphasized, with the result that the section recommended to the council that a committee on this subject be organized, to make a survey of the field and aid research workers to cooperate in advancing our knowledge of the photosynthetic process as rapidly as possible. The council authorized such a committee and instructed the general secretary to take steps to organize it.

It was the general opinion, expressed by those in attendance, that the program gave a most interesting and important summary of progress in chemistry, particularly with reference to those topics that are of most interest to other scientists and to the public. Most of the papers presented were discussed at length by the chemists present, and the discussion was enlivened by the witty and relevant remarks and suggestions of the chairman.

On nomination by the section, the council elected E. W. Washburn, of the National Research Council, to be the chairman of the section and association vice-president for the section, for 1923. On similar nomination W. D. Harkins was elected to be secretary of Section C for the remainder of the secretarial term, expiring at the end of the Washington meeting, December, 1924. Gerhard Dietrichson, of the University of Illinois, was elected assistant secretary, and two members of the section committee were elected, as follows: For the four-year term expiring at the end of 1925, Gregory Paul Baxter, Harvard University; for the four-year term expiring at the end of 1926, Roger Adams, University of Illinois.

A more complete report on the sessions of Section C at Boston will appear in a later issue of SCIENCE, as will also the vice-presidential address for the section.

SECTION D—ASTRONOMY

Vice-president and Chairman, Otto Klotz.

Retiring vice-president, S. A. Mitchell.

Secretary, F. R. Moulton, University of Chicago, Chicago, Ill.

(Report by F. R. Moulton)

Section D held its meeting on Friday afternoon, December 29, in joint session with the American Astronomical Society. In the absence of Professor S. A. Mitchell, his retiring vice-presidential address on "Some consequences of ionization" was read by Dr. Slocum. Other meetings were held, under the auspices of the American Astronomical Society, on Wednesday morning, Thursday morning and afternoon and Friday morning. The section was adjourned Wednesday afternoon to attend the symposium on "Space and time" given by Section A and the American Mathematical Society. On Wednesday evening the section and the American Astronomical Society were entertained by Dr. and Mrs. Shapley at the Harvard College Observatory.

At the business session of Section D, Dr. Heber D. Curtis, Allegheny Observatory, Pittsburgh, Pa., was nominated for vice-president for Section D for 1923, and Dr. Charles G. Abbott, of the Smithsonian Institution, Washington, D. C., was elected member of the sectional committee for the term expiring December 31, 1926.

THE AMERICAN ASTRONOMICAL SOCIETY

President, W. W. Campbell.

Secretary, Joel Stebbins, Washburn Observatory, Madison, Wis.

(Report by Joel Stebbins)

The American Astronomical Society had a successful meeting, about eighty members being present. Sessions were held on three days, and the society took the opportunity to join the meetings of other sections, including the symposium on "Space and time" of Section A and a joint session for papers of common interest with the American Physical Society. In the case of the physical papers a prominent physicist stated that anything he understood was probably astronomy and what he did not understand must have been physics. In a session with Section D the retiring address of Vice-president S. A. Mitchell on "The importance of ionization" included a practical summary of certain developments in modern physics which are of prime importance in their astronomical application.

In addition to the emphasis on physics, the meeting brought out about half a dozen papers in each of the following fields: astronomical spectroscopy, stellar parallaxes, positions and proper motions of stars, and double and variable stars. One might suppose that by the twentieth century astronomers would have learned all possible ways of setting up their instruments, but no less than three papers included notes on methods of adjustment of equatorial telescopes, special devices being occasioned by the new forms of instruments which are being brought into use.

In 1918 the society held at Cambridge what turned out to be a farewell meeting in honor of the late Professor Edward C. Pickering, director of the Harvard Observatory for more than forty years, and it was a satisfaction for the members to visit once more the scene of his labors and see how the work is being carried on and extended by the new director, Dr. Shapley. Also the society was privileged to hold a session at the Harvard Astronomical Laboratory, where, under the late Professor Willson and his successor, Dr. Stetson, many innovations in the teaching of astronomy have been introduced.

Although the Boston meeting was not marked by the announcement of any striking astronomical discovery, the gathering was quite up to standard in the interest and benefits to astronomers themselves, both because of the quality of the technical papers and the opportunity of contact with workers in allied sciences.

SECTION E—GEOLOGY AND GEOGRAPHY

Vice-president and chairman, Hervey W. Shimer.

Retiring vice-president, Willet G. Miller.

Secretary, Elwood S. Moore, University of Toronto, Toronto, Ontario.

(Report by E. S. Moore)

Section E held a successful meeting with a program of three full days and an evening session in conjunction with the association, at which Dr. W. M. Davis gave a public lecture on the Grand Canyon. One of the gratifying features of the meeting was the interest manifested by the younger geologists and geographers, and it is regrettable that an abstract of each paper presented can not be published here.

In his paper on "Variations in rate of evolution of organisms," Dr. Shimer, vice-president, pointed out that characters of major importance such as those distinguishing classes, are introduced with comparative rapidity. Throughout the much longer subsequent life of the class, evolution, except for the few individuals which initiate the next great advance, is confined to the elaboration of minor characters. Such alternations in the rapidity of evolution may partly be explained by a parallel alternation in the physical environment throughout the history of the earth.

As an outcome of a paper given by Dr. W. M. Davis on the possibilities of developing geological features, for educational purposes, in city parks, a resolution was unanimously passed, urging that such possibilities be brought to the attention of park authorities concerned. Professor Davis pointed out features which might be used in some of the principal cities in the country. A few of the examples suggested are the glacial features in Central Park, New York, which could be exposed by removing the thin earth covering. Spokane might develop a magnificent section exhibiting the remnants of the great flood of Columbia lavas left lying unconformably on the spur of the Rocky Mountains. Another paper by Professor Davis, of exceptional interest, expressed his conclusions regarding the origin of the Drowned Coral Reefs south of Japan. The Tiu Kiu and Bonin islands are surrounded by coral banks 40 to 60 fathoms in depth, and these are believed to represent submerged coral reef plains, built up around the islands while they were slowly subsiding during a period of higher temperature than that existing at present. The corals are believed to have ceased work, owing to a fall in temperature. The submergence is assigned to a sinking of the islands, rather than to a rise of the sea, because the depths of the various banks are not the same. These islands are of skeleton outline with serrate backbone, from which slender rib-like spurs project on either side, between open bays. Barrier coral reefs are more or less developed around the more southern islands, while the middle island groups have only narrow and discontinuous fringing reefs. Professor Davis thinks that the margin of the coral seas fluctuated during glacial time and recently withdrew somewhat toward the equator.

Professor S. D. Townley exhibited views which showed that earthquakes are relatively more numerous in southern California than in the northern and central portion, and that there is really no reason why just as much care should not be taken in constructing earthquake-proof buildings in the southern cities as in San Francisco. Photographs showing destructive effects of earthquakes indicated that an earthquake near Lovelock, Nevada, occurred in an uninhabited region. If a city had happened to be located near it, great destruction would have resulted.

A map of California, showing the location of all faults, is being prepared as an aid to a more thorough study of seismology. Most people are inclined to think all modern earthquakes in the United States have occurred in the western portion of the country. Mr. I. B. Crosby showed that a severe earthquake occurred in the vicinity of Boston in 1755, by which 1,200 chimneys were partially, or totally, destroyed in this region and some houses were nearly destroyed. This was the severest shock which has been recorded, but since then other shocks of lesser magnitude have occurred, and it is quite within the bounds of possibility that others may occur in the future. An interesting map, prepared by Mr. Crosby, shows the areas around Boston likely to suffer most from a shock, because of the characer of the underlying rock. Mr. R. W. Sayles presented undoubted evidence of the glacial origin of the beds at Squantum and other localities, and pointed out the relation between the regularly banded slates in a number of areas and the seasonal changes resulting from glaciation. Recent studies indicate the glacial origin of the Swanton conglomerate near St. Albans, Vt. Professor R. V. Field presented evidence to show that the Torridon sandstone in the northwest Highlands of Scotland, long regarded by the Scottish geologists as a typical desert deposit, is more correctly considered as a formation made up of confluent alluvial fans. From his account of his early geological work in the Red Deer district, Mr. J. B. Tyrrell fully established his claim to the honor of having discovered, in 1884, what is probably the most famous collecting ground in the world for dinosaurian remains.

Recent work by Professor Fairchild and others has shown that the southern limit of glaciation, as outlined by Lewis and generally accepted as correct, must be greatly modified, since this line did not include the extensive lobations running down most of the valleys. The ice reached as far south as Bethlehem and possibly to Reading, Pa. The masses of till left by these lobes do not represent pre-Wisconsin glaciation, but rather the fringe of the Quebec glacier. The topographic features of the lower Susquehanna valley can be best explained by assuming a peripheral bulge, which by isostatic compensation balanced the downthrow of the northern area, which was weighted down by the ice of the Quebec glacier. This bulge is calculated to have had a width of 200 miles and a crest elevation of 640 feet. Since glacial times the bulge has fallen about 200 feet, thus drowning the lower Susquehanna valley. The rise of this bulge implies a downthrow in Quebec during glacial times of 3,000 feet with a post-glacial uplift of 1,000 feet. Before glaciation the Quebec area stood 2,000 feet higher than to-day, or somewhat over 3,000 feet above sea level.

Other evidences of changes in level were discussed by Professor W. F. Jones, who states that the last movement of sea level was about 25 feet downward, leaving a well-marked strand line which is almost world-wide. In the Boston embayment this lowering of sea level was not sufficient to bring above the sea buried peat beds and fish weirs, which had apparently been submerged at some earlier date. In Campeche, Mexico, the 25-foot strand line is well marked, and in it are mounds and lime kilns, covered by marine sediments when the sea stood 25 feet higher. A pyramid at Jounta is wave cut at a point 25 feet above the present level of the sea, and according to the de Geer chronology, it must be over 3,500 years of age. It is probable that a rise of 25 feet in sea level would bring the Maya ruins of Pelengue practically to the coast, and it is estimated that this city existed over 4,500 years ago.

Professor Barton has found many examples around Boston of drumlins deeply eroded by subglacial streams.

One of the most interesting discoveries of its kind recently made is that of E. Thiessen, who has found that the rubber-like mass called "coorongite," found in South Australia, is the "peat stage" of boghead coals. The plant forming this rich oil-bearing substance is a colonial alga-like organism, named, "Elaeococcus," and not previously recognized by botanists. He presents undoubted evidence that the same type of organism exists in abundance in the fossil condition in the bogheads and some cannel coals.

SECTION F—ZOOLOGICAL SCIENCES

Vice-president and chairman, M. M. Metcalf.
Retiring vice-president, C. A. Kofoid.
Secretary, H. W. Rand, Harvard University, Cambridge, Mass.

(*Report by Herbert W. Rand*)

Section F (Zoology) arranged no independent program but met in conjunction wih its several associated societies. Unless otherwise stated, all sessions mentioned below were held in buildings of the Massachusetts Institute of Technology.

The biological smoker on Wednesday evening at the Walker Memorial, Massachusetts Institute of Technology, was attended by (roughly estimated) about five hundred persons. That same evening the Ecological Society of America held its annual dinner at the Athens Café, Boston.

The zoological exhibits, while not extensive in range, included matters of considerable interest. The most elaborate exhibit was that of the American Association of Economic Entomologists, illustrating field and experimental work on the gypsy moth and the European corn borer. An object of unusual general interest was a living specimen of the New Zealand Sphenodon (Hatteria) exhibited by Professor C. C. Nutting, of the State University of Iowa.

The section committee met at the close of the morning session of the Zoologists on Wednesday and proceeded to nominate as vice-president for the Section for 1923 Professor Edward L. Rice, of Ohio Wesleyan University. Also, Dr. Francis B. Sumner, of the Scripps Institution for Biological Research of the University of California, was nominated to succeed the retiring member of the section committee, Professor V. E. Shelford, of the University of Illinois. A business session of Section F was held Friday, December 29, at 9 a. m., with Vice-president Metcalf in the chair. The Section voted that Professor E. L. Rice be nominated to the council of the association as vice-president for 1923, and the nomination of Dr. F. B. Sumner for place on the section committee was confirmed by his election.

THE AMERICAN SOCIETY OF ZOOLOGISTS

President, H. H. Wilder.

Secretary, W. C. Allee, University of Chicago, Ill.

(*Report by Herbert W. Rand*)

Sessions of the American Society of Zoologists were held in the mornings and afternoons of Wednesday, Thursday and Friday, December 27 to 29. The session of Wednesday morning was held in three sections. Section I opened with a considerable list of papers on parasitology and then proceeded to papers on cytology and histology. Section II was arranged to provide for papers having special needs in the way of time or illustration. The main feature of this session was an extended account of the Fiji-New Zealand Expedition from the University of Iowa, presented by Professor C. C. Nutting, with lantern illustrations. Some papers on miscellaneous subjects were included in this session. Section III was held in conjunction with the Botanical Society of America (Joint Genetics Section), the program being devoted to papers dealing with genetics in animals. Further sessions of the Zoologists on Wednesday afternoon and Thursday morning and afternoon were occupied by papers on embryology, comparative anatomy, entomology and general physiology. On Thursday morning there was also a session of the Joint Genetics Section for papers on plant genetics followed by an afternoon session for animal genetics.

The sessions of the American Society of Zoologists were presided over alternately by the president, Professor H. H. Wilder, of Smith College, and by the vice-president of Section F, Professor M. M. Metcalf, of Oberlin College.

Friday morning was devoted to a joint session of the Zoologists and the Ecological Society of America. The program included fourteen titles on ecology and zoogeography and most of the papers were presented.

Friday afternoon the Zoologists met in joint session with the American Society of Naturalists and the Ecological Society of America for a symposium on *Geographical Distribution.* Nine groups were considered, as follows: Mammals, by Glover M. Allen, of the Boston Society of Natural History and the Museum of Comparative Zoology at Harvard University; Birds, by James P. Chapin, of the American Museum of Natural History; Reptiles, by Thomas Barbour, of the Museum of Comparative Zoology at Harvard University (in Dr. Barbour's absence his paper was read by E. R. Dunn); Amphibians, by E. R. Dunn of Smith College; Fishes, by C. H. Eigenmann of Indiana University; Mollusks, by H. A. Pilsbry, of the Philadelphia Academy of Sciences; Onychophora, by C. T. Brues, of the Bussey Institution of Harvard University; Insects, by P. P. Calvert, of the University of Pennsylvania; Echinoderms, by H. L. Clark, of the Museum of Comparative Zoology at Harvard University.

The annual zoologists' dinner took place on Thursday evening at the Parker House, Boston. About one hundred and forty were present. The place of honor was shared by Professor H. H. Wilder of Smith College, president of the American Society of Zoologists, and Professor C. A. Kofoid of the University of California, retiring president of the Zoologists and retiring vice-president of Section F, American Association for the Advancement of Science. In the intervals between the serving of courses a male quartette sang some of Professor Wilder's well known biological songs. After the dinner Professor Kofoid gave his address as retiring president of the zoologists and retiring vice-president of Section F. His subject was "The life cycle of the protozoa." Starting from the conception of the cell as a dynamic entity rather than a thing necessarily limited by a visible cell boundary, he proceeded to a discussion of the Protozoa with a view to showing that the differences between the Protozoa and Metazoa have been over emphasized and that proper recognition of the fundamental similarities in life cycle and reproductive processes might well lead to the regarding of the protozoan as a "one-celled metazoan."

THE ENTOMOLOGICAL SOCIETY OF AMERICA

President, Arthur Gibson.

Secretary, C. L. Metcalf, University of Illinois, Urbana.

(Reports by C. L. Metcalf and Herbert W. Rand)

The seventeenth annual meeting of the Entomological Society of America was usually well attended, the attendance ranging from about seventy-five to two hundred and fifty in the different sessions. Sessions for a program of papers on miscellaneous subjects were held on Tuesday afternoon and Friday morning. A session on Wednesday afternoon was devoted to a symposium on "Adaptation of insects to special environments." The symposium program was divided into two sections. Part I consisted of ten-minute papers, each presenting the more noteworthy examples of adaptations to the particular environment discussed, the more striking features of the habitat and something of the course of evolution or development of the adaptation. Part II consisted of three-minute papers, each dealing with adaptation in a single species of insect or with a single unit of adaptation.

The annual public address of the society was given Wednesday evening by Professor W. M. Wheeler, dean of the Bussey Institution of Harvard University. His subject was "The physiognomy of insects."

The society held its dinner on Friday evening, with about one hundred and fifty present. Seventy-four new members were elected during the past year, bringing the total membership to 652, the largest in the history of the society.

The following officers were elected: *President,* Professor T. D. A. Cockerell, University of Colorado, Boulder, Colo.; *first vice-president,* Dr. Wm. S. Marshall, University of Wisconsin, Madison, Wis.; *second vice-president,* Dr. F. E. Lutz, American Museum of Natural History, New York City; *secretary-treasurer,* Dr. C. L. Metcalf, University of Illinois, Urbana, Ill.; *managing editor of the annals,* Professor Herbert Osborn, Ohio State University, Columbus, Ohio; *additional members of the executive committee,* Mr. Arthur Gibson, Dominion entomologist, Ottawa, Canada, Dr. W. A. Riley, University of Minnesota, St. Paul, Minn., Professor R. A. Cooley, Agricultural Experiment Station, Bozeman, Mont., Charles W. Johnson, Boston Society of Natural History, Boston, Mass., Dr. E. P. Felt, state entomologist, Albany, New York, Professor A. L. Melander, State College, Pullman, Wash.

The society voted to raise the annual dues from $2 to $3, effective January 1, 1924. Professor J. J. Davis, of Purdue University, was appointed treasurer of the Thomas Say Foundation, to succeed Dr. E. D. Ball, resigned. Messrs. R. A. Cooley, R. W. Harned and Guy C. Crampton were elected as new members of the editorial board of the *Annals.*

The society approved the constitution for the Union of American Biological Societies, as published in SCIENCE for September 29, 1922, and appointed Messrs. A. N. Caudell and A. G. Boving as the representatives of the society to attend such meetings as may be called during the coming year.

The following subject was selected for the symposium at the Cincinnati meeting in 1923: "Methods of protection and defence among insects."

THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

President, J. G. Sanders.

Secretary, A. F. Burgess, Melrose Highlands, Mass.

(Report by A. F. Burgess)

The thirty-fifth annual meeting of the American Association of Economic Entomologists was held in Massachusetts Institute of Technology, Cambridge, Mass., December 28 to 30, 1922. Professor James G. Sanders, chief, Bureau of Plant Industry, Harrisburg, Pa., presided throughout the meetings, and on Thursday morning delivered his presidential address entitled "Whither in entomology?"

The meeting was the largest ever held by this association, over one hundred and eighty members and a large number of visitors being present. All sections of the United States and Canada were represented, a number of members coming from the Pacific Coast.

Papers bearing on some of the large problems in controlling destructive introduced insects were presented and discussed, and a considerable part of the program was devoted to experimental work on insecticides for use in controlling insect pests of plant life. Important contributions relative to protecting such economic crops as cabbage, potatoes, tobacco, onions, peas, beans and other truck crops, as well as stored products, fruits, grain and green-house plants, from injury by insect pests, were given during the meeting.

The program of papers was large and varied, and ranged from the protection of golf greens from the larvæ of the Japanese beetle, and spraying from airplanes to the prevention of loss of domestic fowl from eating rose chafers and observations on horse flies in Louisiana.

The Section on Apiculture held its meeting on Thursday evening at the Boston Society of Natural History, where an extremely interesting program was presented. A number of local beekeepers and others interested in the subject attended this session, and many more would doubtless have been present had the weather been more favorable.

The Section on Horticultural Inspection was devoted to a number of papers and discussions on nursery and orchard inspection and quarantine work. The viewpoint of the nurserymen was presented by Mr. F. F. Rockwell, representing the American Association of Nurserymen. A general discussion of nursery stock fumigation also formed a part of the program. A statement concerning the gipsy-moth situation in New Jersey was also presented.

On Friday afternoon a symposium was held on the "Standards for training men who are to enter professional entomology." Addresses relating to this subject were presented by some of the foremost economic entomologists and best known teachers in this country. It was a session of particular interest to all the members and many visitors.

On Saturday morning a joint meeting was held with the American Phytopathological Society, at which the subject of plant quarantines was presented from different points of view and was generally discussed.

The widespread effect of these quarantines, as well as their value, is not fully appreciated by the general public. The protection they afford to the farmer is not well understood. The need for more precautions in preventing foreign pests from finding lodgment in this country was brought out very forcibly, and it was clearly shown that money expended for such protection was an extremely good investment.

The entomologists interested in the insect pest survey, which is designed to secure countrywide data on the abundance and destructiveness of insect pests year by year, and the entomologists engaged in extension work in the various states, held a very profitable meeting, which was devoted largely to a discussion of the problems at hand with a view to adopting better methods and securing more effective cooperation.

The group of the entomologists interested in insects affecting the health of man met with Section N of the American association and with other scientists who are working along related lines. This resulted in a very profitable conference.

An exhibit was prepared which filled one of the large rooms and illustrated the different methods used on the gipsy moth work and the corn borer work, together with charts and models showing the results of different lines of experimental work and the equipment and devices used in studying these insects as well as their parasites and natural enemies. Smaller exhibits of improved devices for laboratory use and excellent drawings of a number of insects and their work excited much favorable comment. The exhibit was a valuable addition to the meeting and was visited and examined in much detail by most of the members.

The Boston meeting was the largest one that has been held by this association and the papers were of more than ordinary interest. Seventy-six new members were elected and the association was reported to be in good financial condition.

It was voted to take membership in the Union of Biological Societies.

The following officers were elected: *President,* A. G. Ruggles, St. Paul, Minn.; *first vice-president,* H. A. Gossard, Wooster, Ohio; *second vice-president,* H. J. Quayle, Riverside, Calif.; *third vice-president,* P. A. Glenn, Urbana, Ill.; *fourth vice-president,* S. A. Fracker, Madison, Wis.; *secretary,* A. F. Burgess, Melrose Highlands, Mass. Committees were also elected to carry on the specialized activities of the association for the current year.

THE AMERICAN NATURE-STUDY SOCIETY

President, William G. Vinal.

Secretary, Mrs. Anna B. Comstock, Ithaca, N. Y.

(Report by Herbert W. Rand)

The Americain Nature-Study Society held sessions on Thursday morning and afternoon and Friday morning and afternoon. These sessions were occupied by a general program. On Saturday morning the society met at the Museum of Comparative Zoology at Harvard University to listen to "Personal Reminiscences of Professor Louis Agassiz," by J. Henry Blake, and to visit the collections in the museum. On Saturday afternoon, in spite of highly unfavorable weather, members of the society visited the Arnold Arboretum of Harvard University, at Jamaica Plain, under the guidance of Professor John G. Jack.

The American Nature-Study Society held a dinner Thursday evening at the Hotel Bellevue, Boston, in honor of Mrs. Anna Botsford Comstock, who is retiring as professor of nature-study at Cornell University.

UNION OF AMERICAN BIOLOGICAL SOCIETIES

(Report by I. F. Lewis)

At the meeting of the association and affiliated societies in Boston the proposal to form the Union of American Biological Societies was acted upon by many of the societies. Data as to all the societies so acting are not yet at hand, but it is evident that the idea of cooperation is meeting rather general acceptance. The following societies, officially or unofficially, have decided to become members of the union: The American Physiological Society, the American Phytopathological Society, the American Society of Agronomy, the American Society for Horticular Science, the American Society of Naturalists, the American Society of Zoologists, the Botanical Society of America and the Entomological Society of America. The American Association for the Advancement of Science, and its four biological sections (F, G, N, O) voted to join the union, provided the special societies on the original list decide to do so. The action of other societies has not yet been reported and will be included in a later statement.

A meeting of the council consisting of two representatives from each society becoming a member will be arranged in the early spring in Washington.

At this meeting definite projects for carrying out the purposes of the union will be set under way. The expenses of the meeting will be met in part by an appropriation from the National Research Council, to whose invaluable assistance along with the sympathetic cooperation of the American Association for the Advancement of Science, the initial success of the union is so largely due.

SECTION H—ANTHROPOLOGY

Vice-president and chairman, T. Wingate Todd.

Retiring vice-president, A. E. Jenks.

Secretary, E. A. Hooton, Peabody Museum, Cambridge, Mass.

(Report of E. A. Hooton)

Section H (Anthropology) of the American Association for the Advancement of Science, the American Anthropological Association, the American Folk-Lore Society and the Maya Society held their annual meetings in Cambridge, December 27-29, 1922. Most of the sessions were held in the Massachusetts Institute of Technology and the remainder in the Peabody Museum of Harvard University.

The attendance upon the meetings was excellent and a total of fifty-five papers was presented before the various societies. The first day of the meeting was entirely devoted to contributions on physical anthropology read before Section H. Many of these dealt with new evidence upon the nature and extent of racial and individual variation in man. Dr. Aleš Hrdlička, of the U. S. National Museum, discussed the significance of recent finds of fossil man in the Old World; Adolph Schultz, of the Carnegie Institution, offered new information upon fetal growth in man; C. B. Davenport, of the Station for Experimental Evolution, Cold Spring Harbor, N. Y., spoke on the heredity of build in man. An interesting feature of the session was the discussion of practical aspects of physical anthropology. Several important contributions to this subject were presented, among them two especially stimulating papers on the application of anthropology to clinical medicine, by Dr. George Draper and David Seegal of the Presbyterian Hospital, New York. The limitations of space preclude the mention here of some fifteen other meritorious papers, most of which will be published shortly.

Officers of Section H were nominated by the section, and were subsequently elected by the council of the American Association for the Advancement of Science, as follows: *Vice-president and chairman (1923)*, E. A. Hooton, Harvard University; *secretary (1923-1924)*, R. J. Terry, Washington University, St. Louis, Mo.; *member of section committee (1924-1926)*, R. B. Bean, University of Virginia.

THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

President, W. C. Farabee.

Secretary, A. V. Kidder, Phillips Academy, Andover, Mass.

(Report by E. A. Hooton)

The American Anthropological Association had two very profitable sessions, consisting of some nineteen papers on ethnology, archeology, sociology and linguistics. Progress of European archeology was summarized by N. C. Nelson, of the American Museum of Natural History; new paleolithic finds in Siberia were described by George Grant MacCurdy, of Yale University; R. B. Dixon, of Harvard University, read a provocative paper on the racial history of the American Indian; and Chi Li, of Harvard University, aroused much interest by his discussion of anthropological problems of China.

The following officers of the American Anthropological Association were elected: *President*, Walter Hough, U. S. National Museum; *secretary*, A. V. Kidder, Phillips Academy, Andover.

THE AMERICAN FOLK-LORE SOCIETY

President, Frank G. Speck.

Secretary, Charles Peabody, Harvard University, Cambridge, Mass.

(Report by E. A. Hooton)

The American Folk-Lore Society held its annual meeting on the afternoon of December 28. Special features of the program were the demonstration of methods and apparatus of divination among the Bassa of Southern Cameroun, West Africa, by George Schwab, of the Peabody Museum, Harvard University, and a paper by J. Frank Dobie, of the University of Texas, on weather lore of the Texas-Mexican border. Officers were elected as follows: *President*, A. L. Espinosa, Leland Stanford University; *secretary*, Charles Peabody, Peabody Museum, Harvard University; *treasurer*, P. E. Goddard, American Museum of Natural History.

THE MAYA SOCIETY

(Report by E. A. Hooton)

The session of the Maya Society was held on the afternoon of December 29 in the Peabody Museum of Harvard University. In this connection the gold objects found in the sacred cenote of Chichen Itza, Yucatan, were exhibited by the Peabody Museum. Progress in the exploration of the ruined cities of Central America and new interpretations of cultural facts in that area were offered by S. G. Morley, of the Carnegie Institution; H. J. Spinden, of the Peabody Museum; A. M. Tozzer, of Harvard University; Marshall H. Saville, of the Museum of the American Indian, and William Gates, director of antiquities, of Guatemala. A controversial paper on the history of Maya and Aztec numerations was presented by Leo Wiener, of Harvard University. Officers of the society were elected as follows: *President*, William Gates, director of antiquities, Guatemala; *secretary*, Sylvanus G. Morley, Carnegie Institution, Washington, D. C.

SECTION I—PSYCHOLOGY

Vice-president and chairman, R. Dodge.

Retiring vice-president, E. A. Bott.

Secretary, F. N. Freeman, University of Chicago, Ill.

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

President, Knight Dunlap.

Secretary, E. G. Boring, Emerson Hall, Cambridge, Mass.

(Report by F. N. Freeman)

The American Psychological Association held its thirty-first annual meeting in conjunction with the meeting of the association, and the section for psychology (Section I) held no separate session. By a happy arrangement between the program committee of the Psychological Association and the section committee of Section I, place was made on the program of Thursday morning for a symposium organized by the section and on Thursday afternoon for the address of the retiring vice-president for the section, Dr. E. A. Bott. This arrangement seemed to be a very satisfactory one. The psychological meetings were held in Emerson Hall, Harvard University, while the other sections and societies met at the Massachusetts Institute of Technology, some distance away. For this reason, the symposium, which was planned to be of general interest, failed to attract any considerable number of outsiders. The accommodations in Emerson Hall were, however, very convenient. The proximity of the meeting of Section Q (Education) made cross visiting easy, and the setting of the dinner at the nearby Harvard Union on Thursday evening was delightful.

The increase in the number of psychologists makes the organization of a program more difficult each year. In some of the recent meetings there have been a bewildering number of parallel sessions. The program committee succeeded this year in reducing the periods at which parallel sessions were held to two. They did this by holding down the number of papers and classifying them into six groups, dealing with general, applied, experimental, clinical, comparative psychology, and mental measurement.

There is space for only general comments on the technical papers of the program. The prominence of applied psychology was one outstanding feature. Three sessions were devoted to general, experimental and comparative psychology, and five to applied and clinical psychology and mental measurements. The symposium was also devoted to applied psychology. That this proportion does not necessarily indicate the relative importance of the two parts of the field is obvious, but it indicates fairly the trend in practice. In spite of this trend, a certain amount of vigorous experimental work is going on, and several theoretical questions are arousing discussion.

The papers in the symposium were of general interest. Professor E. L. Thorndike made the point that much more is known in psychology than is applied and that it would be comparatively easy to lay down applications which would enormously benefit human life. He took illustrations from the facts of individual differences and dwelt at greater length on general facts of human nature, particularly instincts. For example, he argued that legal restrictions upon the expression of the instinct of mastery through gaining economic supremacy may cause it to find expression through more sinister forms of behavior. Dr. C. S. Yoakum discussed the applications of psychology to industry, particularly the analysis of the intellectual and temperamental qualifications of executives. He showed that there is no single type of successful executive and that the success of different types demands different working conditions. Dr. William Healy laid down a series of principles and facts regarding the bearing of psychology on the diagnosis and treatment of delinquency. He emphasized particularly the view that there is no clearly marked type of delinquent and that environment and habit may play a larger part in causation than intellectual ability or inherent traits. Dr. E. B. Mayo, recently of Australia, now at the University of Pennsylvania, discussed with illuminating illustrations the bearing of psychology on economic and industrial life. He dwelt particularly on the fact that unrest may be caused by pathological mental conditions which are subject to alleviation by appropriate treatment.

The address of the retiring vice-president, Dr. E. A. Bott, was concerned with a criticism of the presuppositions that underlie the scientific methods in research. He held that the assumptions which are sometimes dismissed as metaphysical are of importance and that views which frequently seem diverse are really at bottom the same. The address of the president of the association, Dr. Knight Dunlap, which was delivered at the annual dinner, was concerned with the foundations of social psychology. Dr. Dunlap criticized adversely the various current conceptions, particularly the view of instinct as elaborated by McDougall. In place of these views he suggested that the psychology of desire be studied as the foundation of social attitudes and behavior. He also suggested that the facts of social behavior might be experimenally studied in the theater and gave illustrations of beginnings which have been made in such study.

The meetings of Section Q contained a number of items of interest to psychology particularly to the address of the retiring vice-president, Dr. G. M. Whipple, on "The present status of intelligence testing." At the business meeting of the association the annual dues were raised from $2.00 to $5.00 in order to provide more adequate funds for the carrying on of the affairs of the association and for the use of the secretary. The provision regarding the election of members of the Council was amended to provide that the Council should nominate six persons to be voted upon by later ballot. The committee on certification of clinical psychologists presented a report which recommended a reduction in the fee for such certification. This report was subjected to prolonged discussion and was referred to the committee again for later recommendation.

The following officers were elected: *President,* Dr. L. M. Terman, Stanford University; *Secretary,* Dr. John A. Anderson, Yale University; *Members of the Council,* Dr. Edwin G. Boring, of Harvard University, Dr. June E. Downey, of the University of Wyoming; *Members of the Section Committee of Section I,* Dr. R. M. Yerkes, Dr. Raymond Dodge. The association also nominated for appointment to the Division of Anthropology and Psychology of the National Research Council Dr. Raymond Dodge and Dr. R. S. Woodworth. Dr. L. M. Terman, who was elected president, is well known for his work with mental tests and for his study of gifted children.

The association voted to accept the invitation of the University of Wisconsin to meet in Madison in 1923. The dates of the meeting are December 27 to 29.

Since the next year's meeting of the Psychological Association falls within the general region of the meeting of the American Association for the Advancement of Science, which is to be held in Cincinnati, Section I voted to suspend its meeting for 1923. Dr. Raymond Dodge was renominated as vice-president for the succeeding year and was subsequently elected by the association council.

An account of the proceedings and programs in the botanical sciences, social and economic sciences, engineering, medical sciences, agriculture, education and scientific societies related to the American Association in general will be printed in subsequent issues of SCIENCE.

CHARLES D. WALCOTT

PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE FOR THE YEAR 1923

A Biographical Note[1]

Dr. Charles Doolittle Walcott, secretary of the Smithsonian Institution since 1907 and president-elect of the American Association for the Advancement of Science, is descended from early New England settlers. He was born March 31, 1850, at New York Mills, Oneida County, New York, and attended the public schools of Utica and the Utica Academy, which he left in 1868. In early youth he became interested in fossils and minerals and in natural history generally, and at the age of seventeen he had already planned to make a systematic study of the older fossiliferous rocks of North America. From two years' experience in a hardware store he gained much practical business training, but his scientific interests drew him away from commercial enterprises and he returned to farm life and his chosen studies. He arranged to do some farm work in return for board and lodging, on a farm near Trenton Falls, New York, reserving the rest of his time for study and collecting. The years from 1871 to 1876 were spent in this way. In 1873 he sold a fine collection of Trenton limestone fossils to the Museum of Comparative Zoology of Harvard College. He planned to pursue a course of study with Louis Agassiz, but the great naturalist died before this plan could be carried out.

Dr. Walcott's first official appointment came to him in November, 1876, when he became assistant to James Hall, then state geologist of New York. In that position he carried out researches in New York, Ohio, Indiana and Canada. It was in 1876 that he became a member of the American Association for the Advancement of Science, in which he has continued his membership to the present time. He was elected to fellowship in the association in 1882.

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[1] Based on an article that appeared in the *Geological Magazine,* decade vi, Vol. vi, No. 655, pp. 1-10, January, 1919.

In July, 1879, Dr. Walcott became a field assistant in the United States Geological Survey. He studied the high plateaus of southern Utah and the Grand Canyon and afterwards took part in a thorough investigation of the Paleozoic deposits of central Nevada. He was placed in charge of the Paleozoic paleontology of the Geological Survey, but still found time to continue his studies of the older faunas. He examined the Appalachian Cambrian formations from Alabama to Quebec and Newfoundland. He also took up a series of western studies that eventually covered the main Cambrian and pre-Cambrian bodies in the great region from California and Texas to Montana and South Dakota. In 1888 he became paleontologist in charge of invertebrate paleontology, in 1891 he became chief paleontologist, and in 1893 he was advanced to be geologist in charge of geology and paleontology in the survey. In July, 1894, Dr. Walcott was appointed to succeed Major J. W. Powell as director of the United States Geological Survey. He held this position until 1907, when he resigned to become secretary of the Smithsonian Institution, of which he had already been assistant secretary in charge of the National Museum.

His work in the Geological Survey resulted in the reorganization of the survey on scientific and business principles. The Congress and those with whom he came in contact placed continually increasing confidence in his ability and reliability. The United States Reclamation Service was organized under Dr. Walcott's direction between 1902 and 1907. He encouraged public interest in national forestry and secured in 1898 the first comprehensive law organizing the national forest reserves.

From 1902 to 1905 Dr. Walcott was the administrative officer of the newly founded Carnegie Institution of Washington, and he took a large part in the successful organization of that institution. He has been a member of its executive committee since 1902. He was elected to the National Academy of Sciences in 1896 and has been its president since 1917.

During his long and successful term as secretary of the Smithsonian Institution, Dr. Walcott has directed researches in many parts of the world and he has given much personal attention to productive studies of the Canadian Rocky Mountains in British Columbia and Alberta, on which studies he is still engaged. He is well known as a scientist throughout the world, especially as a persistent and successful student of the Cambrian and Algonkian sediments and their included organic remains. Of his studies he says[2] that they "have involved new and somewhat startling discoveries that helped to show how very much earlier life was developed on our planet than we had previously supposed." Furthermore, "these researches have taken into consideration the records left on all the continents and many of the great islands * * * in the hope of finding evidence of the presence of minute and active bacterial and simple algal workers, such as exist in modern seas and lakes."

Dr. Walcott has taken active part in the work of many organizations and committees, connected with the government and otherwise, and he was specially active in many lines of war work. He is a member of many learned societies, both of this and of other countries. He has been the recipient of honorary degrees from the following universities: Hamilton, 1897; Chicago, 1901; Johns Hopkins, 1902; Pennsylvania, 1903; Cambridge (England), 1909; Yale, 1910; St. Andrews (Scotland), 1911; Christiania, 1911; Pittsburgh, 1912; Harvard, 1913. He has been awarded the Hayden Medal (Academy of Natural Sciences of Philadelphia), the Bigsby and Wollaston Medals (Geological Society of London), the Gaudry Medal (Société Geologigue de France). From 1875 onward there have been very few years that are not marked in Dr. Walcott's list of scientific publications, and most of the years of this long period each saw the publication of two or more papers from his hand. In electing Dr. Walcott to be its president for 1923, the American Association for the Advancement of Science has added a worthy name to its long and honorable roll of presidents.

THE ORGANIZATION, WORK AND PURPOSES OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

GENERAL SCOPE

The American Association for the Advancement of Science aims to advance science in the

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[2] Walcott, Charles D.: "Evidences of primitive Life," *Smithsonian Report* for 1915 (Publ. 2389) pp. 235-236, 1916.

New World in every feasible way. It is broadly international in its scope. The majority of its members and all the societies now associated with it are of the United States or Canada, but its field is not limited to those two countries and it has members residing in all parts of the world. All who are interested in the progress of knowledge and education are eligible to membership. During the past seventy-four years the association has played an increasingly important rôle in American scientific and educational improvement. Its organization presents two aspects:

(1) It constitutes a cooperation of many thousands of individuals for the advancement of science and all that this phrase implies. At the close of the fiscal year 1922 (September 30, 1922) there were 10,566 members in good standing, and the membership list included 11,646 names. Its membership represents persons engaged in scientific or educational work or appreciating the value of these lines of activity. The individual members of the association support its projects through financial contributions, which may have the form of *sustaining-membership* contributions, *life-membership* contributions, *annual membership* dues, or *associateship* dues. Contributions of the last two forms are used directly to support the work of the association, while only the income from the first two forms of contribution is thus used, these contributions themselves being permanently invested and very carefully guarded.

(2) The association is also a great general organization of eighty-three wholly autonomous and independent *associated* scientific societies and thirteen local academies of science and learning. Forty-three of the larger associated societies and all of the associated academies are officially *affiliated* with the association. Affiliated societies have representation in the association council and in its section committees, thereby taking part in the control of its affairs. Whether affiliated or not, the associated societies have no responsibility for the financial support of the greater organization, which is borne, as has been said above, solely by the individual members. A list of the associated societies is presented farther on in this issue of SCIENCE.

The association aims to assist, in every feasible way, the work of all men and women of science and that of all scientific and educational organizations, especially those that are associated with it. A large number of the latter regularly meet at the times and places of the association meetings, while many others frequently do so. The facilities of the association, for arranging sessions, etc., are at the disposal of all the societies that meet with it at any of its meetings. Reduced railway rates for the meetings are generally secured. To individual members the organization is valuable in many ways, especially through its publications and through the meetings. The permanent secretary's office is always ready to aid the scientific work of members in every way possible. It is hoped that all members and all associated societies may realize that the American Association for the Advancement of Science is *their* association, and that they will continue to demand of its officers more and better work for the growth of knowledge, for increased popular appreciation of science and the scientific method of thought, and for the improvement of democratic civilization in general. It is also hoped that both the societies and the individual members will enter fully into the spirit of cooperation with the section secretaries, with the permanent secretary's office, and with the other offices and committees of the association, to the end that the services of the association may be still further broadened, its prestige may be still further enhanced, and its power may be still further strengthened, "to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness."

ORGANIZATION

The direction of the association rests in the council, a democratically constituted body that combines the legislative and executive functions. The council consists of the president, the vice-presidents (at present 15 in number), the treasurer, the general secretary, the permanent secretary, the secretaries of the sections (now 15 in number), the council representatives of the affiliated societies and academies (43 societies and 13 academies, with 87 representatives altogether) and eight other members. All council members, excepting the representatives of societies and academies, are elected by the council itself, for it nominates and elects the president, the general and permanent secretaries, the treasurer and the eight additional elected members, and it elects the vice-presidents and section secretaries on nominations by the respective sections. There are 129 council memberships at present, but the same person sometimes serves in more than a single capacity, and there are now 126 names on the council roll. A list of the council members for 1922 has been presented on earlier pages of this issue of SCIENCE. The council meets regularly four or five times during each annual meeting, and interim business is transacted by the executive committee of the council, which consists of the president, the general secretary, the permanent secretary and eight other members elected by the council. The executive committee for 1922 consisted of Simon Flexner, *chairman;* J. P. McMurrich, *president*; D. T. MacDougal, *general secretary*; B. E. Livingston, *permanent secretary*; J. McK. Cattell, H. L. Fairchild, L. O. Howard, W. J. Humphreys, A. A. Noyes, Herbert Osborn and H. B. Ward. For 1923 the personnel remains the same, with the exception that Dr. McMurrich is succeeded by Dr. Walcott, the president-elect.

The association has fifteen sections, representing the main current subdivisions of science, and each is designated by a letter, as follows: A (Mathematics), B (Physics), C (Chemistry), D (Astronomy), E (Geology and Geography), F (Zoological Sciences), G (Botanical Sciences), H (Anthropology), I (Psychology), K (Social and Economic Sciences), L (Historical and Philological Sciences), M (Engineering), N (Medical Sciences), O (Agriculture), Q (Education). Members of the association may be enrolled in one or more sections and a card file of its members is maintained for each section. Section P is planned for Manufactures and Commerce, but has not yet been organized.

ACTIVITIES

The activities of the association are, in general, of three kinds, those related to the holding of the annual and other meetings, those related to publications and those related to the advance of knowledge by research. These may be briefly considered in order.

MEETINGS

The regular annual meetings, now held in the winter, during convocation week, are made possible by the organization of the association. A local committee for each meeting is organized, which has charge of all local details. These meetings are the only large gatherings of the kind that include all branches of science. They present to the people an orderly exposition of all the branches of American scientific thought. These, and the other meetings that are occasionally held, constitute a powerful means of disseminating knowledge, of cultivating the scientific attitude of mind and of promoting a general appreciation of the great importance of science and scientific study. For each meeting the association organizes a publicity service, which gives to the daily press authoritative accounts regarding science. The meetings also furnish the only means by which such a large number of active workers in all branches of science are brought together from distant regions, with consequent opportunities for the formation and renewal of numerous personal acquaintanceships and friendships.

When an associated society meets with the others of the group all of its needs are cared for through the organization of the association. In these cases the society officers are freed from most of the preliminary work that must always be done in preparing for a society meeting. The association does not urge that associated special scientific societies should always meet with the larger group representing all the sciences; there are good reasons why some societies should generally meet at other times and places, and why some should frequently or occasionally do so. This matter is of course decided by each society for itself. But the association does *invite* all scientific societies to meet with it, especially at the greater four-yearly meetings, and it proffers the machinery of its organization for the advantage of all societies that accept this invitation. It asks the officers of societies that meet elsewhere and at other times to consider seriously how they may be able, nevertheless, to aid their respective section committees to present their respective fields of science in an adequate and impressive way, and the council representatives of the societies to take active part in the work of the association. In a great exposition of American scientific work such as one of the annual meeting of the association, as well as in the conduct of its affairs in general, it is surely desirable that the work of every special scientific society should be well represented. In the absence of the associated societies a section committee arranges the program for its field of scientific work; in the presence of the societies the program is mainly left in their hands.

The council aims to select meeting places in such a way as to bring the meetings successively into the various regions of the United States and Canada, in order that all members may frequently attend without too extensive journeys, and that the wholesome local publicity for scientific work and the general educational influences that always result from the meetings may be brought to all quarters of the two countries.

PUBLICATIONS

The weekly journal SCIENCE, official organ of the association, furnishes an open forum for the discussion of questions regarding science and education. Almost every branch of scientific knowledge is represented in its columns. Many shorter scientific contributions of the results of research are published in SCIENCE, which probably has a larger circulation than any other journal that embraces the entire scientific field.

Since SCIENCE became the official organ of the association for the publication of its official anouncements and the reports of its meetings, the annual publication of a volume of proceedings has been discontinued, and volumes of summarized proceedings have been published in their stead. Two volumes of this kind have appeared—one in 1915, covering four years, and one in 1921, covering six years. Each of these volumes presents the lists of officers, etc., for each of the years in question, together with references to SCIENCE for the presidential and vice-presidential addresses and other official communications for these years. It also includes the complete membership list as this stood at the date of printing.

The membership list of the association forms one of the most valuable instruments of its kind as an address list of American scientific workers and friends of science. The 1921 list contains about 12,000 names and addresses, and furnishes a valuable reference volume at a very low cost. Fellows of the association as well as life and sustaining members are specially designated. The publication of the membership list is a valuable and important service performed by the association in the interest of intercourse and cooperation among men of science in America.

From time to time the council of the association has adopted resolutions calling attention to various matters that pertain to the general welfare, as this is related to scientific thought and setting forth the position taken by the association in these matters. Such resolutions are published in SCIENCE and are sent to interested persons and organizations.

One of the most important features of the work of the association is the support it gives toward the publication of SCIENCE, and one of its main objects is the publication and wide circulation of this weekly journal. SCIENCE is sent free to all members in good standing. Such members are allowed, however, to receive *The Scientific Monthly* instead of SCIENCE, if they so request. At the beginning of the calendar year a subscription to the journal for that year is ordered from the publishers for each member whose annual dues for the current fiscal year have been paid. As a special accommodation, members who paid dues for the preceding fiscal year are kept on the mailing list of the journal until February 1. The journal is discontinued on the last-named date unless the current dues have been paid. Those paying their dues still later in the year receive the journal from the time the dues are paid, but, as a special favor, may receive the back issues for the current calendar year *if they so request, provided they pay for the transportation of these back issues at the rate of one cent for each copy.*

The summarized proceedings are sold to those whose names appear on the membership list at a price that covers about half of the actual cost of paper and printing. Non-members may purchase the volume at a somewhat higher price. Copies of the 1921 volume may be purchased by members from the permanent secretary for $2.00, by others for $2.50. It is planned to publish the next volume in the fall of 1925.

The association publishes a preliminary announcement for each meeting, which is mailed to all members. It also publishes a general program for each meeting. Each general program of an annual meeting forms an excellent epitome of the status of American science.

ENDOWMENT AND GRANTS FOR RESEARCH

The American association is entrusted with a considerable permanent endowment, which has been derived from gifts and bequests of public-spirited persons and from payments made by sustaining members and life members. The income derived from these funds is employed to advance scientific research. It is annually appropriated for grants, which are made to individuals or scientific organizations, to aid research projects. Applications for financial assistance in scientific investigations are referred to a special committee on grants, which considers the applications and apportions the available funds. For the year 1922 this committee thus apportioned the sum of $4,000 in twenty-one different grants. Recipients of these aids to research make reports to the association, showing how the funds have been expended and the nature of the results obtained.

It is desirable that the endowment of the association be increased whenever possible, and it is hoped that the opportunity thus offered for continuously aiding the increase of useful knowledge may be widely appreciated. All who are interested in the advancement of science by research are urged to bring the existence of this trust fund to the attention of public-spirited and philanthropic men who might become donors, sustaining members or life members of the association. The fundamentally democratic nature of the American association and its broad, general scope constitute an unusual guarantee that funds entrusted to it will be reasonably and efficiently employed in ways calculated to advance science and improve education.

The association offers the most efficient means by which individuals, scientific societies and scientific institutions may unite to hasten the growth of scientific knowledge and to increase public appreciation of what the peoples and nations owe to science and what may be expected of science in the future. The insistent urge of many individuals and organizations, united in such a comprehensive association for the advancement of learning, is capable of exerting a most powerful influence for good in national and international development.

COOPERATION WITH OTHER ORGANIZATIONS

Besides the activities mentioned above, the American association cooperates with other organizations for the advancement of learning. Most of the American scientific societies for special fields of science are affiliated or otherwise associated with the association.

A scientific society may become associated with the American Association on making application to the permanent secretary and upon a vote of the council. No special obligations are involved; but when associated societies meet with the association, the local committee attends to their arrangements, their official programs are published in the general program and their members receive the privilege of reduced railway rates whenever these are secured for the meeting. Their names are shown in the official list of associated societies. Scientific societies are encouraged to become associated with the association.

An associated society may become affiliated with the association upon application to the permanent secretary and upon a vote of the council. Affiliated societies are generally societies for the promotion of scientific research, and they have representation in the council of the association and in its section committees, their representatives being chosen from among the fellows of the association. Members of affiliated societies have the privilege of becoming members of the American association without payment of the usual entrance fee, if they make application before the second October 1 following their entrance into the society. When a society first becomes affiliated this special privilege is offered to all of its members, the offer being open until the second October 1 following the ratification of the arrangements of affiliation. Each affiliated society elects one member of the council of the association, and those societies of which one hundred or more members are fellows of the association elect two council representatives.

Two regional divisions of the association are in very successful operation—the Pacific Division and the Southwestern Division. The former includes all association members residing in Alaska, British Columbia, Washington, Oregon, California, Idaho, Nevada, Utah, Mexico (excepting Sonora and Chihuahua), the Hawaiian and Philippine Islands and other islands of the Pacific. The Southwestern Division includes association members resident in Arizona, New Mexico, Colorado, Sonora, Chihuahua and Texas, west of the Pecos River. These divisions are autonomous, holding annual and other meetings and engaging in projects for the advancement of science in their respective regions. Their individual members are members of the association and have all the rights and privileges of this membership. Excepting newly elected members, members of a division pay their annual dues to the Washington office, and the division receives one dollar for each payment thus collected. New members of a division pay the entrance fee and the first annual dues to the division. The division retains the entrance fee and sends five dollars (the first annual dues) to the permanent secretary's office in Washington; upon the receipt of this the new member is enrolled and the journal is ordered for him, and one dollar is transmitted to the division secretary.

Local branches of the association are authorized; and one such branch has thus far been formed, the State College (Pennsylvania) Branch. This branch has two kinds of members—national (regular members of the association residing in or near State College) and associate (individuals who take part in the work of the branch but who are not members of the association). The affairs of the branch are mainly directed by its national members; it is autonomous in its local work. The branch receives, for its expenses and to promote its activities, the entrance fees (five dollars each) paid by its new national members and fifty cents for each payment of annual dues made by its national members.

State academies of science, excepting those representing states lying within the region of either of the two divisions, may become affiliated with the association, there now being thirteen affiliated academies (including the Southern Education Society in this group). This form of affiliation has been planned to promote the growth of the several academies and especially to aid them in making their meetings increasingly successful and locally influential. Affiliated academies receive the entrance fees collected from new association members who are on their membership lists. They also receive one dollar from each payment of annual dues made to the association by their members.

The association co-operates in other ways with its regional divisions and with its affiliated academies to aid in their work of encouraging local interest and appreciation regarding scientific progress.

Many projects for the advancement of science, for the improvement of education and for increased national and international welfare have received the support of the association. Its Committee of One Hundred on Scientific Research, organized early in 1914, formed the beginning of a nation-wide endeavor to accelerate systematic research and to render the knowledge of individuals more readily available to other individuals and to their government and nation. The National Research Council, of the National Academy of Sciences, is now the most prominent national organization for this work in the United States, and the association cooperates wih the Research Council in many ways toward the advancement of science and the encouragement of scientific research.

The association has been appreciative of the need for improved facilities for bringing published scientific work to the attention of those who would make use of it, such facilities as abstract journals and other similar aids to research. Financial grants were made to aid the *Concilium Bibliographicum* in its earlier years, and *Botanical Abstracts* was similarly helped at a time when such support was greatly appreciated. Both of these enterprises are now in very promising condition, through assistance secured for them by the National Research Council.

The association cooperates with the U. S. National Academy of Sciences and the U. S. National Research Council in the recently founded Science Service whose aim is to disseminate truthful and at the same time readable information about scientific subjects.

It is the aim of the association: To extend its activities in all lines just as rapidly as possible; to make its meetings more efficient and more beneficial; to enlarge the journal and give it a still wider circulation throughout the world, and a farther-reaching influence upon thoughtful people; to become the trustee of increased endowment for scientific research, thereby being able to aid directly in new discoveries and new applications of knowledge.

Scientific Societies Associated with the American Association for the Advancement of Science

(Arranged according to the corresponding sections of the association.)

(Affiliated societies are designated by asterisks; a single asterisk denotes one representative in the association council and two asterisks denote two representatives.)

A. MATHEMATICS

**The American Mathematical Society.
**The Mathematical Association of America.

B. Physics

**The American Physical Society.
*The Optical Society of America.
*The American Meteorological Society.

C. Chemistry

**The American Chemical Society.
The American Institute of Chemical Engineers.
The American Electrochemical Society.

D. Astronomy

**The American Astronomical Society.

E. Geology and Geography

**The Geological Society of America.
**The Seismological Society of America.
The Paleontological Society of America.
**The Association of American Geographers.
**The American Geographical Society.
The National Council of Geography Teachers.
The American Alpine Club.
The Mineralogical Society of America.

F. Zoological Sciences

**The American Society of Zoologists.
**The Entomological Society of America.
**The American Association of Economic Entomologists.
*The Eugenics Research Association.
*American Society of Mammalogists.
The Wilson Ornithological Club.

G. Botany

**The Botanical Society of America.
**The American Phytopathological Society.
The Botanists of the Central States.
The American Fern Society.
The Sullivant Moss Society.

F, G. Zoology and Botany

**The American Society of Naturalists.
**The Ecological Society of America.
**The American Genetic Association.
**The American Microscopical Society.
The American Nature-Study Society.

H. Anthropology

**The American Anthropological Association.
The Archeological Institute of America.
The American Folk-Lore Society.

I. Psychology

**The American Psychological Association.
The Southern Society for Philosophy and Psychology.

K. Social and Economic Sciences

The American Civic Association.
The American Economic Association.
The American Association for Labor Legislation.
The American Metric Association.
The American Sociological Society.
The American Statistical Association.

M. Engineering

**The American Society of Mechanical Engineers.
**The American Institute of Electrical Engineers.
**The American Institute of Mining and Metallurgical Engineers.
**The American Society of Civil Engineers.
**The Illuminating Engineering Society.
*The American Society for Testing Materials.
The American Society of Heating and Ventilating Engineers.
The American Society of Refrigerating Engineers.
The Society for Promotion of Engineering Education.
The American Ceramic Society.

N. Medical Sciences

**The American Medical Association.
*The American Association of Anatomists.
The American Physical Society.
*The Society of American Bacteriologists.
The American Society for Pharmacology and Experimental Therapeutics.
The American Society of Biological Chemists.
The American Society for Experimental Pathology.
The American Public Health Association.
The Society of American Microanalysts.

O. Agriculture

*The American Society of Agronomy.
*The Society of American Foresters.
*The American Society for Horticultural Science.
The American Pomological Society.
The Society for Promotion of Agricultural Science.
The Association of Official Seed Analysts.
The American Society of Animal Production.
*The Canadian Society of Technical Agriculturists.
The American Dairy Science Association.

Q. Education

**The National Society of College Teachers of Education.
**The American Federation of Teachers of the Mathematical and Natural Sciences.
**The National Society for the Study of Education.
The American Philosophical Association.
*The American Association of University Professors.

Societies not specially related to any particular section

**The Society of Sigma Xi.
*The Association of University Professors.
**The Gamma Alpha Graduate Scientific Fraternity.
The Bibliographical Society of America.
The Gamma Sigma Delta Society.
The Phi Kappa Phi Fraternity.
The Phi Delta Kappa Fraternity.

Affiliated Academies of Science, etc.

*The Illinois State Academy of Science.
*The Iowa Academy of Science.
*The Kansas Academy of Science.
*The Kentucky Academy of Science.
*The Maryland Academy of Sciences.
*The Michigan Academy of Science.
*The Nebraska Academy of Science.
*The New Orleans Academy of Sciences.
*The North Carolina Academy of Science.
*The Ohio Academy of Science.
*The Oklahoma Academy of Science.
*The Wisconsin Academy of Sciences, Arts and Letters.
*The Southern Education Society.

MEMBERSHIP IN THE AMERICAN ASSOCIATION

Any person interested in the progress of science and education in any way may become a member of the association, and all are invited to do so. An application and information card is filled in and returned to the permanent secretary, with a remittance covering the amount of the entrance fee ($5) and the amount of the annual dues for the first year ($5).[1] On receipt of this payment by the permanent secretary the journal is ordered. A certificate of membership is sent to each new member as soon as he has been elected.

Any member of an affiliated society may become a member of the association, with all the privileges of membership, on payment of annual dues for the first year ($5), the entrance fee being omitted in such cases, *providing application is made before the second October 1 following the member's election to the affiliated society.* Such application should be made on a special (blue) application card provided for this purpose. This privilege is open also to all members of the three societies mentioned below under "Special Notices."

In making application for membership the blanks on the application card should be carefully filled in, to the end that the permanent secretary's files and the published membership lists prepared therefrom may be correct. Cards may be obtained from the permanent secretary's office at any time.

Life members each pay $100 in one year (having paid the entrance fee or having had it omitted through joining an affiliated society) and are exempt from all further dues.

Sustaining members each pay $1,000 and are exempt from all further dues.

Members who are engaged in scientific work or who have advanced science by research may be elected to fellowship in the association.[2]

SPECIAL NOTICES TO MEMBERS AND PROSPECTIVE MEMBERS OF THE A. A. A. S.

1. The present issue of SCIENCE is sent to all persons whose names are on the roll of the association, whether they regularly receive this journal or the *Scientific Monthly.* For those who have not yet paid their annual dues for 1923, this is the last issue to be sent until after the payment shall have been made. Annual dues were due last October 1. The journal has been continued through January to those few who are still in arrears with the hope that they would find it convenient to pay before the end of the month. It was also thought that those who are still in arrears would appreciate receiving this special issue with its account of the recent Boston meeting.

2. The American association is now nearly seventy-five years old, having been founded in September, 1848. At the next annual meeting to be held in Cincinnati, December 27, 1923, to January 3, 1924, will be celebrated the seventy-fifth anniversary. Special features are being planned.

3. The association will hold a summer meeting in September, 1923, at the University of Southern California, Los Angeles, in conjunction with the Pacific Division and the Southwestern Division.

4. The meeting of December, 1924, is to be held in Washington, D. C., and that of December, 1925, is to be held in Kansas City.

5. All members of the Canadian Society of Technical Agriculturists and all members of the American Association of University Professors are this year invited to join the American Association for the Advancement of Science without payment of the usual entrance fee, because these organizations have recently become officially affiliated with the American Association for the Advancement of Science. By special action, this privilege is open also to all members of the Society of Sigma Xi and to all members of the American Medical Association. Recently elected members of any affiliated society are similarly privileged. To take advantage of this use a blue membership application card and accompany it only by the annual dues for the first year.

BURTON E. LIVINGSTON,
Permanent Secretary

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[1] Persons residing in the region of the Pacific Division or of the Southwestern Division send their applications and remittances for the first year to the division secretary instead of the permanent secretary. For later years they pay their dues to the permanent secretary. New members of the State College Branch pay entrance fees and annual dues for the first year to the branch secretary. For later years their dues are paid to the permanent secretary's office. Members of affiliated societies and academies send applications and all remittances to the permanent secretary.

[2] See the article on Fellowship Elections, elsewhere in this issue of SCIENCE.

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GEOMETRY AND PHYSICS[1]

TWENTY years ago the abstract point of view in geometry was becoming a familiar one to mathematicians. The essential element in the movement of thought at that time seemed to be the freeing of geometry from all reference to physical reality. Geometry as studied by mathematicians must be a set of propositions arranged in a sequence of logical deduction, proceeding from a set of unproved propositions (the axioms, or postulates) which are stated in terms of undefined elements. If the undefined elements are points and lines, for instance, the mathematician does not inquire what is a point or line. All he cares to know about them is stated explicitly in the axioms.

This point of view made it possible for the first time in history to see geometry as a clear-cut whole. It was definitely separated from philosophy on the one side and from other branches of physics and mathematics on the other. The result was a great gain for clearness of thought in all these fields, a gain which has not been accompanied by any loss of mutual contact or support.

During the following years mathematicians have continued to develop the postulational or logistic method, so that by now it has demonstrated its value as a practical scheme of arrangement and exposition in the most diverse branches of mathematics. While doing this it has, of course, lost in freshness what it has gained in respectability. But during the same period a series of brilliant discoveries in physics has been making the abstract point of view a vital issue in that science also.

If we examine the classical branches of physics we shall find that the main elements of the abstract point of view have been implicit in them for a long time. In fact, if we state with sufficient clearness in physical terms what we mean by undefined elements, unproved propositions, and so on, we are apt to find that a physicist classifies these ideas as truisms of little importance. I am inclined to think that he is justified in this attitude, so far as practical results are concerned, during the earlier and cruder stages of physical theory. But experience is showing that when the results of a more refined experimental technique force a reconsideration of fundamental assumptions, the technique of the study of these assumptions must undergo a corresponding refinement. Let us therefore take the risk of banality and glance at some of the branches of physics from the point of view of an axiomatist.

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[1] Address as retiring vice-president and chairman of Section A—Mathematics, American Association for the Advancement of Science, Boston, December, 1922.

Lest any one should expect any closely reasoned body of doctrine to result from such a survey—and thereby be sadly disappointed—let me remind any non-mathematicians who may be present that when a mathematician lays down the elaborate tools by which he achieves precision in his own domain, he is unprepared and awkward in handling the ordinary tools of language. This is why mathematicians always disappoint the expectation that they will be precise and reasonable and clear-cut in their statements about everyday affairs, and why they are, in fact, more fallible than ordinary mortals. Therefore, please be satisfied in this case with some rather disconnected remarks.

We shall begin with elementary geometry, the oldest branch of physics. Having the mathematical, or abstract, science of geometry before us in its present highly developed form, we wish to apply it to the world of experiment. It consists of a sequence of statements arranged in a certain logical order but void of all physical meaning. In order to apply them to nature we identify the undefined terms (points, lines, etc.) as names of recognizable objects. The unproved propositions (axioms) are then given a meaning, and we can ask whether they are true statements. If they are true, then we expect that the theorems which are their logical consequences are also true and that the abstract geometry will take its place as a useful branch of physics.

This, I think, is a fair statement of the accepted point of view. But it is full of serious difficulties. The most obvious one is that it is impossible to identify anything in nature as a point or a line or a plane except by means of more or less gross approximations. The statement that a point has neither length, breadth nor thickness is a useful description in many of the applications of abstract geometry, but it is never strictly true of a physical point. The identification of any physical object as a point (or a hexagon or a sphere) takes place only with a certain margin of error. But if this error is imperceptible in verifying the postulates themselves, there may well be an accumulation of errors when the postulates have been used many times in the proof of a complicated theorem. Thus the postulates may appear true within the limits of error of a direct test, and yet some of the theorems may be perceptibly false. This makes it necessary to verify not merely the postulates, but also as many theorems as possible.

Here let me digress long enough to point out the bearing of this on the problems of teaching. The branch of physics which is called Elementary Geometry was long ago delivered into the hands of mathematicians for the purposes of instruction. But, while mathematicians are often quite competent in their knowledge of the abstract structure of the subject, they are rarely so in their grasp of its physical meaning. In recent years this defect has become glaringly apparent and the teachers of elementary geometry are beginning to cultivate the experimental technique of the subject. What I wish to say is that they should do this with a view not merely to making the concepts of geometry clear to their students, but also with a view to removing the legitimate doubts of its truth which students have a right to entertain.

The knowledge that the experimental verification of any theorem, however far removed from the axioms, is a real argument in favor of the validity of the whole science should strengthen the hands of those who want to make the teaching of geometry as concrete and physical as possible. Gauss and other experimenters who have taken pains to verify that the sum of the angles of a triangle is 180 degrees were not wasting their time; and neither is a teacher doing so who finds new tests for this and other theorems of geometry.

At the same time it will not be forgotten that the physical reality of geometry cannot be put in evidence with full clarity unless there is an abstract theory also. The faults in the traditional teaching of geometry, about which we hear so much to-day, are in a large measure due to the opinion that geometry is a system of *a priori* truth of such a nature that our belief in it cannot be influenced by experiment. A science resting on such a supernatural basis was fittingly taught by the method of dogmatic indoctrination.

The existence of a margin of error in the process of identifying concretely the abstract terms of geometry means that we never verify a very large number of cases of a very large number of theorems in a single group of experiments. In one experiment, and with one interpretation of the terms, we verify the theorem of Pythagoras, but it is in another experiment, and with another interpretation of the terms, that we verify the theorem of Desargues. Thus we can know the physical truth of geometry only, as it were, in patches. The unity of the science is in its abstract formulation.

This situation is not an unusual one in physical science, for theories are by no means unknown in which the postulates and many of the theorems are quite beyond the reach of experiment. Such theories have to be tested by verifying some of their consequences. I suppose that it is a very exceptional theory which can be fully tested by a single series of experiments.

There is, however, an experimental difficulty which is especially characteristic of elementary geometry. This is the bewildering multiplicity of concrete interpretations for the same abstract term. A point, for the purposes of instruction, is usually a spot on a blackboard. If you are trying to steer a course at sea you may fix your attention on two points which are a lighthouse and a red spar respectively. In this case you are making use of the proposition that a straight line is uniquely determined by two of its points. The same proposition can be verified by driving the nails *A*, *B*, and *C* into a wooden board and observing that if a stretched string which touches *A* and *B* also touches *C*, then a stretched string which touches *B* and *C* can be made to touch *A*. The same experiment can be repeated by sighting from one nail to the others or by the use of a straight edge or by firing a bullet from a gun.

I could continue enumerating these illustrations indefinitely, but the point I am making is sufficiently evident. There is no unique way of defining a point or a line for the purpose of experiment. Indeed, the great usefulness of elementary geometry is very largely due to the fact that there is such an extraordinary multiplicity of things which can profitably be regarded as points and lines.

In this multiplicity of interpretation of its fundamental terms, elementary geometry is in sharp contrast with the more recent and recondite branches of physics. Thus, for example, while the term electron may have more than one physical meaning, it is by no means such a protean object as a point or a triangle. The old way of accounting for this difference was to say that the electron is a substantial object, whereas the point is only an abstraction. This way of dismissing the question will not satisfy us to-day, for we believe that the electron and the point are both abstractions. Moreover, the difference which we are seeking to explain is one of degree rather than of kind.

What we are calling elementary geometry is, of course, not a single logical unit. It comprises first of all a group of theorems of analysis situs. These culminate in the theorem that the points are in one-to-one correspondence with the totality of ordered sets of three numbers, (x, y, z); in other words, that an analytic geometry is possible. In this part of geometry, the multiplicity of possible physical interpretations of the terms is at its highest pitch. Following this we have projective geometry, the general theory of straightness; affine geometry, the theory of parallels; and, finally, the metric geometry. Each one of these groups of theorems is logically distinguished from its predecessor by the appearance of new relations which are brought in either by means of new axioms and undefined terms or by means of definitions which limit attention to a restricted class among the totality of possible geometrical objects. At each stage the freedom of physical interpretation is restricted until, at the final stage, it is necessary to be able to specify the physical significance of a measuring stick and of a rectangular cartesian coordinate system.

Next after geometry, according to the classical way of looking at things, we can take up either kinematics or statics or the geometry of masses. Let us choose the first of these three alternatives.

For kinematics we must have a theory of time. This is very simple; the undefined terms are "instant" and "before" or "after," and we use as postulates one of the sets of postulates for the linear continuum. The main theorem is that there is a one-to-one continuous correspondence between the instants of time and the numbers of the real number system. This makes possible the subdivision of time into equal intervals, and the measurement of time. While the abstract theory is very simple at this stage, the physical applications involve all the technique of clocks and other time devices.

For kinematics we must also have the concept of substance, something which can move and which can have a duration in time. The postulates for substance will state its existence, as we say, in space and in time. They may be phrased somewhat as follows:

1. Given any substance and any instant of time, there exists a unique set of points called the *position* of the substance at the given instant of time.

A substance whose position at any time is a single point is called a *particle*.

2. The position of any particle at any time is a single point. This position is a continuous function of the time.

3. For every point P of the position of a substance S at any time there is a particle whose position is P. The position of S at any other time t' is the set of points which are the positions of these particles at the time t'. These particles are called the particles of the substance S.

4. No two particles of the same substance can have the same position at the same time.

5. Let (x_0, y_0, z_0) be the coordinates in a cartesian coordinate system of the position of any particle of a substance S at a time t_0 and let (x, y, z) be the coordinates of the same particle at a time t, then there exist three analytic functions f_1, f_2, f_3 such that

$$\begin{aligned} x &= f_1\ (x_0, y_0, z_0) \\ y &= f_2\ (x_0, y_0, z_0) \\ z &= f_3\ (x_0, y_0, z_0) \end{aligned}$$

for all the particles of S.

The first four of these postulates correspond to our most general intuitions about substance, and the fifth is intended as a basis for analytic operations. While I have studied out some of their consequences, I have not made anything like a full investigation and should not be surprised to find that they contain both omissions and redundancies. I give them here largely to emphasize the fact that very little work has yet been done in this direction.

Before we have the actual structure of the classical kinematics we must limit our attention not merely to the consequences of these axioms of time and substance, but also to a group of theorems determined by certain definitions. The most important of these is the definition of uniform motion of translation. A substance is in uniform motion of translation if with respect to a definite cartesian coordinate system and a definite time variable, we have for every particle of the substance

$$\frac{d^2x}{dt^2} = \frac{d^2y}{dt^2} = \frac{d^2z}{dt^2} = 0.$$

This simple way of stating the definition can be replaced by the apparently more complicated statement:

If a substance S is at rest there is a cartesian coordinate system and a system of time measurement such that the coordinates of each particle of S satisfy the conditions

$$\begin{aligned} x &= \text{constant} \\ y &= \text{constant} \\ z &= \text{constant} \\ t &= \text{arbitrary.} \end{aligned}$$

If a substance S' is in uniform motion of translation there is another coordinate system such that each particle of S' is denoted by

$$\begin{aligned} \bar{x} &= \text{constant} \\ \bar{y} &= \text{constant} \\ \bar{z} &= \text{constant} \\ \bar{t} &= \text{arbitrary.} \end{aligned}$$

and the relation between the two coordinate systems is given by equations

$$
\begin{aligned}
(1)\quad \bar{t} &= a\ \ t + b \\
\bar{x} &= a_{11}x + a_{12}y + a_{13}z + b_1t + c_1 \\
\bar{y} &= a_{21}x + a_{22}y + a_{23}z + b_2t + c_2 \\
\bar{z} &= a_{31}x + a_{32}y + a_{33}z + b_3t + c_3
\end{aligned}
$$

in which the coefficients are constants such that

$$d\bar{x}^2 + d\bar{y}^2 + d\bar{z}^2 = dx^2 + dy^2 + dz^2.$$

Before the physical applications can be made in detail, corresponding definitions must be made of uniform motion of rotation and of other special types of motion. But we need not go into this question here.

The physical interpretation of the abstract theory is much more definite and restricted at the present stage than it was at that of geometry. The table before us, the floor on which we stand, we ourselves, the whole earth, are all substances moving together through space with a high velocity. Any description of the whole or any part of this aggregation of substances is a concrete application of kinematics and gives rise to an experimental test of it.

We now see that the multiplicity of concrete interpretations of geometry was due in part (though not wholly) to the fact that geometry is used to describe an instantaneous cross section of the substantial universe. At this stage also we have to meet the difficulties due to the fact that the motion of any substance can only be detected physically as the motion of the one substance relative to the other substances.

The abstract theory which we have described provides for absolute motion, *i. e.*, a substance is in motion if the set of points which we call its position is not the same at all instants of time. But it is also true that the theorems of the universe of substance will be unchanged in meaning if we replace the abstract time and space which underlie the theory of substance by a new time and space related to the old ones by formulas of the same form as (1). It is for this reason that an absolutely definite statement of what we mean physically by particular substances does not carry with it a unique determination of what we mean by particular instants of time or points of space.

The fact, somewhat obscurely understood, that it is possible to make these transformations of the space and time underlying kinematics without altering the kinematics itself has often been taken as an argument against the classical theory of space and time. I do not think it can be accepted as a valid objection, however. What it really does prove is, that when the classical theories of space and time are combined in the theory of substance, the result is more complicated than a simple-minded person would expect.

This complication of the abstract theory shows itself on the physical side when we ask how we shall know what are the simultaneous positions of two distant substances. The discussions of the theory of relativity have shown that the most natural physical method of answering this question corresponds with sufficient accuracy to the classical kinematics when attention is limited to terrestrial objects of not too fine-grained a character. On an astronomical scale, however, the determination of simultaneity fits in much better with the type of kinematics known as the special theory of relativity.

This theory we can regard as proceeding from exactly the same axioms of space, time and substance as those we have proposed for the classical kinematics. But it makes use of a different definition of uniform motion: A substance S' is in uniform motion of translation if, and only if, there is a coordinate system such that each particle of S' is denoted by $\bar{x}$ = constant, $\bar{y}$ = constant, $\bar{z}$ = constant, $\bar{t}$ = arbitrary, and the relation between this coordinate system and the (x, y, z, t) system is given by any set of linear equations with constant coefficient such that

$$d\bar{x}^2 + d\bar{y}^2 + d\bar{z}^2 - c^2d\bar{t}^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$$

where c is a constant.

The relation of the relativity kinematics to its underlying space and time is quite analogous to that of the classical kinematics to its underlying space and time. Analogous transformations of the underlying space and time (the Lorentz group) are possible without changing the kinematics. But in the relativity theory these transformations are put in evidence in connection with the simplest problems, whereas the classical kinematics can be treated in such a way as to mask them.

This is not the place to go further with an exposition either of the classical or of the relativity kinematics. I wish only to remark that either of them can be based on an underlying theory of space and time as well as upon the concept of a four dimensional space-time. There is no essential difference of logical simplicity between the two types of kinematics. The important difference is that the relativity definition of simultaneity is more nearly in accordance with the physical means in actual use by astronomers for determining when two events are simultaneous than is the classical definition. Therefore in those cases where the scale of operations is large enough, or the scheme of measurement fine enough, the relativity kinematics will be used. In other cases the classical kinematics will be retained as a sufficiently accurate approximation to the other.

In comparing the theorems of kinematics with experience there is much less overlapping than in geometry. For a physical object has to be identified as a substance in the kinematic sense not merely once but for all values of the time. Nevertheless, a great multiplicity of interpretation still persists, which will be further reduced when we come into the domain of mechanics.

Before we arrive at a full-fledged mechanics we must introduce the concept of mass. This may be done in two ways according as we are developing a mechanics of discrete particles or a mechanics of continuous substances. In the first case we have merely to postulate a number associated with each particle and in the second case to lay down a somewhat more extensive set of postulates from which the concept of density may be derived. These postulates will serve for example as a basis for the differential equations of continuity.

Finally the postulates must be introduced which determine how we shall use the terms force and cause. I shall not now try to set forth my ideas as to how these postulates should be formulated, for I have already gone more into detail than is desirable in a talk of this kind in expounding the idea of substance. It is enough to remark that there is an open field here for a valuable postulational investigation.

Suppose now that we have before us the complete logical structure which is built on these postulates and consider a particular mechanical problem, as, for example, the problem of two bodies. For the sake of this problem we add to the general postulates of mechanics the postulate that the substance to be considered consists of two particles of given masses moving under a particular law of force. The differential equations now become perfectly definite and numerical results can be worked out.

In order to have a physical application we may let the two particles be the two components of a double star. In this case the astronomical data have a low percentage precision and the theory gets along within a wide margin of probable error. Again, we may let the two particles be the sun and Jupiter. In this case the precision of the astronomical data is high. The theory serves as a first approximation. But it is soon seen that the sun and Jupiter must be regarded as parts of a more complicated mechanical system—and so, in order to pursue the astronomical problem further, we pass on to another abstract theory. In general a whole series of more and more complicated abstract theories will be applied to the same astronomical problem. But the further we go in this direction the more precise becomes the physical significance of each term and the further we are from that multiple interpretation of terms which we noted in elementary geometry.

The same sort of remarks can be made about any other mechanical problem—for example, the problem to find the position of equilibrium of a door hanging freely in a wind of given velocity on hinges whose axes make a given angle with the vertical. It is necessary to supplement the general assumptions of mechanics by additional ones which specify the particular problem. And when we have done so, the application to nature is very definite.

This state of affairs is in part due to the fact that the postulates for mechanics do not form a categorical set, and can not form a categorical set until the substance and the forces are specified in a particular way. In the narrow sense of the words, mechanics is not a mathematical science, but is the group of theorems common to a collection of sciences. Each particular problem involves certain axioms in addition to those of mechanics in general.

It should perhaps be emphasized once more that nothing of this sort is true of elementary geometry. Its axioms form a categorical set. The relations among the points of space are completely determinate, and are unaffected by any of the additional assumptions required for a problem of mechanics. A typical problem of geometry is to determine the truth or falsity of a given theorem. Problems of this sort arise in mechanics, but a typical problem of mechanics requires the construction of a new theory. This is why mechanics is so interesting and so difficult.

The abstract treatments of a great many branches of physics fall within the province of mechanics as it is here understood, but there are a number of others, such as the theory of heat and of electromagnetic phenomena, which are not thus included and which I can not touch on now. But in their classical forms they have all had an underlying "space in which"—described by the Euclidean geometry—and an underlying time continuum. Situated in this space and time there are particles of substance (matter, electricity) all moving about under the influence of forces. The more abstract concepts, such as energy and entropy, have been defined in terms of these more easily comprehended undefined terms. But it is inevitable that the tendency to regard these new concepts as more and more fundamental should lead to the replacement of the old undefined terms by new ones which seem more adequate even if they are more perplexing.

An early illustration of the tendency to formulate problems in terms far removed from the obvious ones is to be found in the general equations of dynamics. Here we find as the coordinates of a dynamical system any set of parameters q^1, q^2, . . . q^n adequate to define it. In a very general class of cases these parameters are regarded as coordinates of a point in a Riemann space whose linear element is determined by the expression for kinetic energy. The geodesics of this space give the paths of the representative point of a mechanical system in the absence of impressed forces and the Lagrange equations express the divergences from these paths brought about by the impressed forces.

In this general mechanics the Riemann space figures as a mathematical device, in which it is highly suggestive to regard the geodesics as analogues of the straight lines in Euclidean space. For one of the most fruitful ways of looking at a straight line physically is to regard it as the path of a particle which has been given an initial velocity and is far enough away from other objects to be but little influenced by them. The motion of a particle in a general case is the result of a balancing of the tendency to follow a straight line with uniform velocity against the forces causing divergences from this norm. With the use of generalized coordinates this situation is reproduced in a generalized form in a Riemann space.

It is an important step beyond this to use the Riemann geometry from the very beginning as Einstein does in his theory of gravitation. To describe the motion of a particle which is left to itself, this theory does not presuppose an underlying space and time whose properties are completely determined in advance. Instead, it assumes that any event in the history of the particle can be identified in terms of four coordinates, x^1, x^2, x^3, x^4, and the totality of these sets of coordinates is assumed to constitute a Riemann space in which there is a linear element,

$$(2) \qquad ds^2 = \sum_{i,j} g_{ij}\, dx^i\, dx^j$$

The relations of these geodesics among themselves are different in the neighborhood of material bodies from what they are in regions where there are no material bodies. In regions of the latter type these relations are approximately the same as those among the geodesics of the space-time manifold of the special relativity.

The relations among the geodesics are determined by the functions g_{ij}. Therefore, if we wish to describe two different distributions of matter we require two different Riemann spaces. We can not, as in the old theories, simply put a new filler in the old container space. The allowable choices of the functions g_{ij} are restricted by requiring them to satisfy a set of partial differential equations which is chosen, in the main, on the basis of its simplicity. In one special case, the one-body problem, it is possible to solve these differential equations and obtain a set of g's and a Riemann space which correspond to a single mass of matter.

Let the numerical constant be chosen so that this mass represents the sun. The planets are particles in comparison with the sun. Therefore, the orbits should be determined by the geodesics of this Riemann space. This determines for each planet a one-parameter continuous family of values of the quantities x^1, x^2, x^3, x^4, which can be compared with values obtained by observation.

Contrast this with the treatment of the same problem by the Newtonian method. Here we have a central attracting mass in a Euclidean space and a system of ellipses as the particle paths. If we go to the space-time manifold we get a system of spirals which have the ellipses as projections. Thus, in this case as in the other, we have a four-dimensional manifold and in it a system of curves. Although the mathematical theories from which the two systems of curves were derived are radically different, yet with proper restrictions the one system of curves can be regarded as a good approximation to the other, and we can pass from the one to the other by means of a differential correction.

When it comes to the comparison of these two systems of curves with nature, we have to recognize that the astronomers work out what they assign as the coordinates of the heavenly bodies by elaborate and indirect observation and calculation. The parameters which they thus determine have to be compared in a somewhat arbitrary way with those which enter into the abstract theories. It was found that in the case of the planet Mercury this fit could not be made with complete exactness for the classical theory, but that when the differential correction was applied which corresponds to the transition to the new theory, the fit became as good as could be expected.

The differential equations of the geodesics can be written in the form

$$(3) \qquad \frac{d^2x^i}{ds^2} + \sum_{\alpha,\beta} \Gamma^i_{\alpha\beta} \frac{dx^\alpha}{ds} \frac{dx^\beta}{ds} = 0.$$

Among the curves which satisfy these equations are not only the geodesics which we have been talking about, but also a family of curves for which $ds = 0$. These curves differ but little from those which represent the motion of light in the older theories. Let us therefore assume that the new curves represent the motion of light. If we do, the differential change from the old to the new curves gives the magnitude of the effect on light of a gravitational field. This effect was predicted by Einstein and the prediction was brilliantly fulfilled.

Both of these successes of the new theory have to do with properties of the differential equations (3) and only indirectly with the functions g_{ij} of (2). The functions $\Gamma^i_{\alpha\beta}$ which appear in (3) are expressed in terms of the g's in (2) but do not depend on the physical meaning of the g's. It is otherwise with the third important prediction of Einstein, that having to do with a shift of the spectral lines. This depends on an explicit physical interpretation of the g's. Its experimental verification is very complicated and whether the outcome will be favorable or unfavorable is doubtful. In the meantime it is interesting to notice that this prediction is logically separable from the other two.

The general situation which arises here is worthy of a great deal of study. A set of differential equations (3) in which the functions Γ are arbitrary, determines a system of curves having the property that any two points in a sufficiently small region are joined by one and only one of the curves. We are thus in the presence of a broad generalization of the Riemann geometry which it has been proposed, in a paper by Professor Eisenhart and myself, to call the geometry of paths. The intuitive idea suggested by this name is that we are dealing not with the empty void of analysis situs, but with a manifold in which we find our way around by means of the paths. It may also serve to remind us that we have a generalization of an inertial field, for the characteristic of a field of inertia is that through every point and in every direction, there is a path which may be taken by a free particle.

A system of paths is also that which takes the place of the ether which has played so varied a rôle in the physics of the last hundred years. It is the paths in the space-time manifold which are the bearers of the energies and stresses which lead to the properties of light and electromagnetism.

From the work of Weyl, who has made the most important contributions to the geometry of paths, it follows that there is not only an affine but also a projective geometry of paths.

The affine geometry consists of those theorems which deal with the concept of infinitesimal parallelism defined by means of the functions Γ. The projective geometry deals with those properties of the paths that are so general as to be independent of any particular definition of parallelism. That there is such a projective geometry follows from the fact that more than one set of functions Γ can be found to define the same set of paths.

Incidentally, it is an interesting comment on the progress of mathematics that the classification of theorems into projective, affine and metric is not here based on the group concept. For the group of a space of paths is in general the identity.

These remarks are, of course, very general and can have little meaning to one who has not given some consideration to the analytic details. But it is essential that they should be made in the sort of a survey I am attempting, because the geometry of paths can be regarded as a generalization both of the earliest part of elementary geometry and of some of the most refined of physical theories. The study of the projective, the affine and the metric geometry of paths ought to result in a comprehensive idea of what types of physical theory it is possible to construct along the lines which have been successful in the past.

The development of physical theories in the recent past has been characterized by a progressively greater and greater use of different types of non-Euclidean geometry. In all cases, however, the underlying analysis situs properties are the same. Whether we are dealing with three, four or n dimensions, we are dealing with a cell, *i. e.*, a portion of a manifold which can be mapped continuously on the interior of a sphere in a Euclidean space of the right number of dimensions.

The obvious question suggests itself, whether it will not be necessary in the future to reconsider this assumption also. The question whether space should be assumed to be continuous has indeed already been raised in a shadowy form by Riemann and others. But even if space be assumed continuous it does not follow that every point in it can be enclosed by a region like the interior of a sphere. Many examples to the contrary are known to students of analysis situs. One such example is a singular manifold defined by "polar coordinates" r, θ, φ, in which $(0, \theta, \varphi)$ represent a single point, the origin, no matter what θ and φ are and in which (r, θ, φ) represents the same point as $(r, \theta + 2n\pi, \varphi + 2n\pi)$ in case $0 < r < 1$. The locus $r =$ constant is an anchor ring and encloses the origin. You can readily convince yourself that there is no sphere enclosing the origin and hence that the origin is a point which has no neighborhood of the sort that exists in the Euclidean or Riemann geometries.

A corresponding line singularity can easily be defined in a four dimensional manifold and may well turn out to be a promising candidate for consideration as the world line of an ultimate particle of some sort. It has an extraordinary degree of indestructibility, and the paths that can be drawn in its neighborhood fall into discrete classes in a most suggestive way. It is not at all impossible that this or some other type of analysis situs singularity will enable us to maintain the continuity of space and yet take account of the discontinuous phenomena that are being observed.

Suppose, however, that it should turn out to be necessary to assume some sort of a discontinuous space. This would have at least one effect that would be pleasing to some of us. It would upset a great many of the cosmological speculations of the present era. In particular it would do away with that depressing view which is so often presented to us of the future state of the universe, a dead, cold world at a uniform level of energy and entropy. It would also tend to prevent our following a light ray too far off toward infinity—or all the way round a closed path—whichever the case may be supposed to be.

In order to have a definite idea of a discontinuous space-time, let us consider a modular case, *i. e.*, a space-time defined by four coordinates (x, y, z, t) which are whole numbers reduced modulo P, and let us suppose that P is an enormously large prime. The number system, modulo P, is one in which every rational operation can be carried out. Let us set a portion of these numbers into correspondence with the ordinary number system of analysis in the following manner: Let k be a fixed number which is small in comparison with P and yet large in comparison with the numbers used in physics and astronomy; and let every rational fraction p/q in the modular number system for which p and q are less than k, correspond to the number p/q of the ordinary number system.

This correspondence between the number systems determines an analogous partial correspondence between the modular space-time and the ordinary space-time, by the expedient of letting the event (x, y, z, t) of the modular space-time correspond to the event (x, y, z, t) of the ordinary space-time, provided that the coordinates are all numbers which correspond.

If we wish to distinguish physically between the two space-times it is obvious that we must succeed in identifying an event in the one which does not have a corresponding event with the same coordinates in the other. This possibility can be obviated for all experiments that have hitherto been made by simply choosing k and P very large.

Nevertheless, if P is finite, the ordinary geometry, mechanics and electromagnetism are only a sort of approximation to the underlying modular geometry, mechanics and electromagnetism. They do not state actual theorems but only approximate results of a validity limited by the number k. For example, when we say that an event (x, y, z, t) is between two events (a, b, c, t) and $(\alpha, \beta, \gamma, t)$ we mean that $x = a + \lambda(\alpha - a)$, $y = b + \lambda(\beta - b)$, $z = c + \lambda(\gamma - c)$, where λ is less than 1 and expressible in the form p/q with q less than k. If we managed to subdivide the interval between the two events more than k times we should presently find that we were no longer between the two original events, but somewhere outside. For in the modular space-time there is no absolute system of order relations. We only have a partial system of order relations based on the correspondence limited by the number k.

It is for this reason that there are no absolute inequalities of the sort that appear in ordinary mechanics, and that no statements can be made which apply to unlimited amounts of space or of time or which require more than a limited subdivision of space and time. Hence the speculations to which I referred above about the ultimate fate of the universe, or about its distant parts, become impossible. Indeed, it becomes impossible to formulate the questions which these speculations purport to answer.

But if the current geometry and mechanics can be fitted so exactly to a space-time of so utterly different a character as a modular one, there are doubtless many other types of discontinuous space-time to which they can be equally well fitted. The moral with regard to all speculation which goes beyond the reach of experiment is obvious. But if it should be found that one of these discontinuous space-times fitted experimental results better than the continuous one, the situation might be radically altered.

Let us, however, apply our moral to ourselves and let these idle speculations go no further. Instead, let me urge once more the importance of further studies of the foundations of the classical branches of mechanics. It is true that the new conceptions of space and time are so varied as to have in common not much more than the idea that it is possible to characterize natural phenomena in an orderly way by means of sets of numbers. This is about as much as all experimental physicists and mathematicians would accept dogmatically. It is also true that elementary geometry and mechanics lay down a very particular system of rules according to which the sets of numbers are to be applied to phenomena. But these rules are such as our everyday experience has made second nature to us, for the experiments confirming them, although crude, are being continually repeated. Moreover, the rules are so good that they can be used in almost any theory as the preliminary way of assigning the coordinates from which the final coordinates can be calculated by variational methods. New theories are very apt to function merely as differential corrections to old ones.

Hence there need be no fear that further work devoted to perfecting the classical theories will be wasted. They will continue to be the instruments by which the vast majority of the facts of science are classified and to be regarded as the necessary preliminaries to the more esoteric theories. Those who have a taste for logistic work may therefore be urged wholeheartedly to devote their attention to formulating the postulates of the classical theories. There also seems to me to be a possibility of simplifying and modernizing the methods used in these theories and of extending the results by bringing in more of the modern methods of mathematics, but that is not the present subject of discussion. What I wish to emphasize now is the need of logistic studies which will make it possible to say more definitely than is yet possible in this field what is assumed, what is proved, and how the group of theorems and definitions hang together. Incidentally, I would propose that the number of undefined terms be made large, rather than as small as possible, for whenever we introduce a new undefined term we separate off a group of theorems in which this term appears. Thus the undefined terms should be so chosen as to subdivide the science into divisions which are convenient both for mathematical and for physical purposes.

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PASTEUR, THE MAN[1]

Pasteur has told us that scientific understanding comes to the "prepared mind." In reading the splendid "Life of Pasteur" written by his son-in-law, Vallery-Radot, as well as the more recent tributes by Duclaux and by Descour, one is impressed by the lack of detail as to how Pasteur's own mind became "prepared." The story has lately been told in greater detail by Marc Tiffeneau.[2] Pasteur, as everybody knows, was the son of a tanner who had been a soldier under Napoleon. Pasteur entered the École Normale at Paris when he was twenty-one years old, and graduated three years later in 1846. He became a demonstrator (agrégé préparateur) in chemistry, a position which had just been established in order to allow young men to continue their laboratory researches instead of exiling them to provincial professorships. About the same period, in the year 1845, Auguste Laurent left the chair of chemistry at the University of Bordeaux, which he had occupied since 1838, because he did not find there sufficient opportunity for research. Arriving in Paris, he accepted the offer of a new laboratory in the École Normale, and it was not long before Laurent recognized the exceptional character of his young assistant, Pasteur, an ardent worker and a brilliant thinker. Laurent was at this time thirty-eight years old. He was the son of simple French peasants; he was born, lived and died poor. When twenty-two years of age he graduated as engineer of mines and later became the assistant of Dumas, who taught him the principles of organic analysis. His doctor's thesis considered the doctrine of chemical substitutions, which is one of the pillars of the atomic theory, and the thesis described specifically the action of chlorine on organic compounds. He and his inseparable friend, Gerhardt, were the real founders of the atomic theory. Laurent now suggested to Pasteur the subject of his thesis, which also involved the then great controversy of chemical substitutions. On August 23, 1847, Pasteur presented for his doctorate a paper entitled "Research into the saturation capacity of arsenious acid. A study of the arsenites of potash, soda and ammonia." Pasteur herein writes regarding Laurent that he had been "enlightened by the kindly advice of a man so distinguished both by his talent and by his character."

And on another occasion he says, "Laurent's lectures are as bold as his writings, and his lessons are making a great sensation among chemists." For Laurent, in 1846, gave the first course on "chemical anatomy" under the Faculty of Medicine of Paris to crowded classrooms, and here for the first time enunciated the atomic doctrine before medical students.

Laurent, having been trained as a mining engineer, had a remarkable knowledge of crystallography, and in 1845, according to Tiffeneau, had shocked his colleagues by declaring that substances which were isomeric could crystallize in different systems.

When Laurent left the laboratory in 1847 Pasteur was already the master of his technic. Shortly thereafter Pasteur became interested in the relation between chemical structure and the power to rotate polarized light, from which arose his celebrated studies upon the molecular dissymmetry of tartaric acid published in 1848.

To Biot, an old man of seventy-four who

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[1] An address delivered on the centenary of the birth of Pasteur on December 27, 1922, before a meeting of the Federation of Societies for Experimental Biology held at Toronto, Canada.

[2] Tiffeneau, M.: *Bull. Soc. française de la histoire de médicine,* 1921, 15, 46.

had first applied the polariscope in the study of the rotation of glucose solutions, he demonstrated that by picking out right and left-handed hemihedral crystals of tartaric acid and making of them separate solutions, these solutions were respectively dextro- and levo-rotary. Pasteur relates the outcome in these words, "Then, very visibly affected, the illustrious old man took me by the arm and said, 'My dear child, I have loved science so much all my life that this makes my heart throb.'"

In one of his letters Pasteur exclaims, "I, who did so love my crystals."

It has seemed worth while to consider how the youthful, highly receptive mind of Pasteur struggled out of its native environment to receive the endowment obtained in Paris from intellectual association with the best the world had to offer. While inheritance from good germinal protoplasm may be an essential factor of intellectual power, yet in science the training of the mind at the hands of a master, so that the fruitful knowledge of the time is sown in younger and not yet worn-out mental soil, is the secret of advance from generation to generation. Pasteur himself sowed this seed in the minds of Calmette, Chamberland, Roux and Metchnikoff. A colonial dependency of Great Britain having half the population of the present city of New York produced Benjamin Franklin and Benjamin Thompson at the same time that it produced Washington, Alexander Hamilton and John Jay. But the minds of Franklin and Thompson were stamped with manifold European contacts.

The scientific mind is more than a good intellectual inheritance, more than that a great master has had it in charge, and Pasteur has thus described it: "The illusions of an experimenter form a great part of his power. These are the preconceived ideas which serve to guide him. Many of them vanish in the long path which he must travel, but one fine day he discovers and proves that some of them are adequate to the truth. Then he finds himself master of facts and of new principles, the application of which sooner or later bestows their benefits."

United with this imaginative power went prodigious industry. Pasteur was not one of those who sat all day at his desk and expected others to accomplish the physical work of the laboratory in the execution of his thoughts. This man at least did not seek to avoid physical drudgery in the simple surroundings of the humble French laboratories of his day. Reflecting on the huge sums spent on the Opéra, he writes to the official *Moniteur*, "I implore you take some interest in those sacred dwellings meaningly described as laboratories." The lesson taught by the consecration of his life to a life of labor in a laboratory is that the true laboratory worker is a laborer and not a loafer.

Pasteur shows his character in writing a wonderful tribute to Claude Bernard at a time when the latter was very ill, causing Bernard to remark that the article "paralyzed the vasomotor nerves of my sympathetic system and caused me to blush to the roots of my hair." One academician wrote of this affair, "The public will learn, among other things, that the eminent members of the academy admire and love each other, sometimes with no jealousy."

Pasteur, as the world knows, was convinced that the process of alcoholic fermentation was bound up in the life of the yeast cell, a doctrine violently combatted by Liebig "with a vigor and obstinacy characteristic of the man and inversely proportional to the strength of the argument" (F. J. Moore). The discovery later by Buchner that a zymase could be expressed from yeast which would produce alcoholic fermentation, does not invalidate Pasteur's thesis, for Rubner has shown that ninety-five per cent. or more of the activity of yeast is actually due to the metabolism of glucose within the living cell.

A very human characteristic develops in the story of the life of Pasteur when we are told of his dismay and distress to find, after the death of his true and trusted friend Claude Bernard, some notes which threw doubt upon Pasteur's interpretation of alcoholic fermentation! How often this human weakness occurs! I have sat next to a member of the Federation of Societies for Experimental Biology at a time of the dismemberment of one of his theories at the hands of another member and heard the agonizing cry, "I thought X was a friend of mine." Heart-breaking and human though this be, it is logically absurd to build friendship upon the basis of a similarity of intellectual metabolism.

It is not necessary here to refer to Pasteur's services to the world in the subjects of bacteriology and immunology. Suffice it to say that they have saved to France alone many times the cost of the Franco-Prussian war of 1870. And this transforming work of Pasteur may be contrasted with an early statement of Liebig, expressed in 1845, "As to the opinion which explains putrefaction of animal substances by the presence of microscopic animalcules, it may be compared to that of a child who would explain the rapidity of the Rhine by attributing it to the violent movements of the numerous mill-wheels at Mayence."

Finally, let it be remembered that Pasteur was a deeply religious man. On Armistice Day, 1918, the London crowd at first instinctively surged to Buckingham Palace, where lives the king, and then instinctively to St. Paul's Cathedral. Pasteur puts it thus: "The idea of God is a form of the idea of the Infinite. As long as the mystery of the Infinite weighs on human thought, temples will be erected for the worship of the Infinite, whether God is called Brahma, Allah, Jehovah or Jesus; and on the pavement of those temples men will be seen kneeling, prostrated, annihilated in the thought of the Infinite."

He himself lived a life closely approaching the infinitely valuable.

GRAHAM LUSK
CORNELL UNIVERSITY MEDICAL SCHOOL

SCIENTIFIC EVENTS

THE PAN-PACIFIC SCIENCE CONGRESS

ON the representations of the Australian National Research Council, it has been decided to hold the next Pan-Pacific Science Congress in Australia in 1923. The meeting will commence at Melbourne on August 13 and terminate at Sydney on September 3. The event will be an important one in the history of Australian and Pacific science. The commonwealth government through its prime minister, Mr. W. M. Hughes, has decided to extend its support to the meeting, and has agreed to provide the sum of £5,000 towards the cost. Invitations to send representatives have been issued by the commonwealth government to the various countries bordering the Pacific or having interests therein, while the Australian National Research Council is inviting a large number of leading scientific men who are interested in Pacific matters to attend and take part in the proceedings.

The first Pan-Pacific Science Congress was held in Honolulu in August, 1920, and the work accomplished on that occasion served to show the great value and importance of such meetings between representatives in and around the Pacific. It is proposed that these congresses so successfully inaugurated at Honolulu should be continued triennially. In addition to the benefit arising from the interchange of scientific thought, a mingling of leaders of science will tend to the bringing about of a better understanding between the peoples of the Pacific.

Among the office bearers are the following:

Australian National Research Council: Professor Orme Masson, The University, Melbourne, *president;* R. H. Cambage, Royal Society, Sydney, *honorary secretary-treasurer;* Professor A. C. D. Rivett, The University, Melbourne, *joint honorary secretary.*

Pan-Pacific Committee: Professor Sir Edgeworth David, The University, Sydney, *chairman;* E. C. Andrews, Mines Department, Sydney, *honorary secretary.*

The tentative list of subjects for papers and discussion is as follows:

A. *Agriculture and Veterinary Science:* Soil problems, climate in relation to crops, plant pathology and plant breeding. Diseases of livestock in the Pacific region: Methods of eradication and control.

B. *Anthropology and Ethnology:* Polynesian and Melanesian races, Australian aborigines, totems, languages, folk-lore, anatomy.

C. *Biology:* General plant distribution in the Pacific; floras of island groups and of individual islands. Insects harmful to the planter and farmer. Role of insects in transmitting disease and the control of weed pests. The distribution of animals. Fisheries.

D. *Geography and Oceanography:* Marine currents, continental shelves, charting in the Pacific.

E. *Geology:* Coral reefs, glaciation, structure of the Pacific region, Carboniferous and Permian problem, correlation of Cretaceous and Kainozoic sediments in Pacific, mineral resources, vulcanology, geological surveys.

F. *Hygiene and Climatology:* Mining hygiene, ventilation, dust prevention. Tropical diseases, hookworm, malaria. Climate in its relation to human efficiency.

G. *Physics:* Isostasy, arc of meridian in Australia, longitude by wireless, weather cycles and weather forecasting.

INTERNATIONAL CONFERENCE OF PHYTOPATHOLOGY AND ECONOMIC ENTOMOLOGY

ANNOUNCEMENTS have recently been received in this country inviting plant pathologists and entomologists to attend an International Conference of Phytopathology and Economic Entomology in Holland during June, 1923. Arrangements for this conference are in charge of a committee composed of Professor Dr. H. M. Quanjer, Professor Dr. Johanna Westerdijk, N. van Poeteren, T. A. C. Schoevers, J. Hudig, Dr. E. van Slogteren, G. Kruseman, J. C. Dorst, J. G. Hazeloop, E. H. Krelage and J. H. van Straaten van Nes.

The committee invites those who wish to read papers or bring up for discussion urgent questions on plant diseases or insect pests. The titles and short abstracts of the papers or questions for discussion should be sent in advance to the secretary, Mr. T. A. C. Schoevers, Villapark 8, Wageningen. The official language of the conference will be English, but papers can be read and discussion held in either English, French or German.

The conference will be held from June 25 to June 30, 1923, and participants are invited to arrive at Wageningen on Sunday, June 24. The following program has been arranged:

Monday, June 25: Presidential address of welcome and lecture on plant diseases as seen from the standpoint of general pathology. Demonstration of experiments, especially on potato diseases. In the afternoon and evening addresses, papers and discussions.

Tuesday, June 26: Address by Mr. van Poeteren on organization and methods of the Dutch Phytopathological Service. Discussion on international laws and requirements. In the afternoon demonstrations of some methods of control of pests and diseases as practiced in Holland, *e. g.*, the furrowing-wheel to destroy leather-jackets, control of American gooseberry mildew, of smut and stripe in grain crops, etc. Evening meeting: Addresses, papers and discussions.

Wednesday, June 27, and Thursday, June 28: Trips through the country. To prevent congestion of the program, participants are requested to subdivide into those interested in agriculture and those interested in horticulture. On Wednesday morning the first group will travel by rail to Friesland, where farms and selection-fields of potatoes are to be visited; next day Groningen Agricultural Experiment Station, address of Mr. Hudig on diseases of crops on alkaline and sour soils, and visit to Mr. Hudig's experiments. Visit to the Experimental Farm of the Groningen Seed Growers' Association.

The second group will visit first the nurseries of Boskoop and Aalsmeer, situated in a typical Dutch country region below sea level; thereafter visit to the bulb-growing districts near Haarlem. Dr. v. Slogteren will address the company and give a demonstration on modern methods of combatting some bulb diseases, *e. g.*, eelworm. This trip will end with a visit to the early potato districts of North Holland, where selection is practiced.

It would be possible to form a third group for visiting other centers of culture, such as the Westland, the most important district growing vegetables and fruit under glass; afterwards the orchards in North Holland and the early potato fields in the same district might be visited.

Friday, June 29: Meeting of Baarn; address of Professor Westerdijk on the cultivation of parasitic fungi and demonstration of research work. Afternoon devoted to discussions and inspection of the international collection of fungi-cultures. This meeting will be continued during the evening for addresses, papers and discussions, and to Saturday morning, if desired.

Saturday, June 30: In the afternoon of that day the conference will leave for the Hague, for an informal meeting at the office of the minister of agriculture. Thereafter the committee will entertain all participants at dinner in the bathing resort Scheveningen.

All scientific men planning to attend the conference should notify Secretary Schoevers in order that proper arrangements may be made for transportation and entertainment.

APPALACHIAN FIELD TRIP

MEMBERS of the Department of Geology in the Mississippi Agricultural and Mechanical College in the late summer of 1922 completed an Appalachian field trip in two automobile trucks, touring parts of eight states and covering more than 2,000 miles in direct travel.

From the college to Tuscaloosa, the whole of the Cretaceous was crossed. At various places from Birmingham, through Anniston, Gadsden, Chattanooga, Cleveland and Knoxville, to Jellico, numerous stratigraphic sections of the Paleozoic beds were measured and many structure sections of the Southern Appalachians were made. On a side trip from Cleveland to Ducktown, Copper Hill and beyond, Archeozoic and Proterozoic beds were examined. In addition, coal, iron, zinc and copper mines; dolomite, limestone, slate and marble quarries; and iron, aluminum, and acid (industrial) plants were visited.

Across central Kentucky, the Blue Grass region of horizontally-bedded limestones was traversed. From Cincinnati to Columbus and thence across southeastern Indiana to New Albany, the glaciated area was studied. In western Kentucky, from Louisville to Mammoth Cave and Bowling Green, the cave and sink topography was almost continuously under observation. Thence the beautiful Blue Grass region of Tennessee, the phosphate mines about Nashville, the Wilson Dam power project at Muscle Shoals, and finally home.

From seats of vantage in the trucks, which passed across the plains, down into the valley depths, and over the mountain tops, the ever present and continuous opportunity was one of unobstructed vision. Under such conditions on this trip from a Gulf state to a Great Lakes state and back over a different route, obviously the great thing was the study of some of the larger phases of geology. Especially is this true of that part which may be termed geologic control of industrial environment. It was the major feature of the trip.

The tour aroused considerable interest among members of geologic departments of a number of universities and in deference to their requests it may be appropriate to mention something about the equipment, expense, etc. The two trucks were one-ton, high-gear Fords, equipped with bodies especially designed for field trips about the college. Three of the four seats were removed from one of the cars and in it the baggage and camp equipment were carried, while the other one was used as a passenger car. Only the maintenance (gasoline, repairs, etc.) cost, which scarcely exceeded the original individual deposit of twenty-five dollars, was charged to the members of the party, consisting of two instructors, Professors Morse and Vestal, and ten students. The living expense was approximately the same amount.

W. O. M.

REPORT OF THE DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

In his annual report to the board of managers Dr. N. L. Britton, director-in-chief of the New York Botanical Garden, stressed the need of funds to more completely develop the usefulness of the garden, commented on the greatly increased interest in plants of all kinds and spoke of the difficulty of preserving the beauty of the natural features of the reservation with the constantly growing number of visitors and with what he characterized as insufficient police supervision.

The following officers were elected to the Board of Managers: Dr. Frederic S. Lee, *president;* Henry W. de Forest and Frank L. Sturgis, *vice-presidents;* John L. Merrill, *treasurer;* Henry de la Montague, Jr., *assistant treasurer;* Dr. N. L. Britton, *secretary.* For the last three years Dr. Lee has served as vice-president of the board.

Dr. Britton's report deals with the progress made in the improvement of the grounds, in the increase, development and study of the collections of plants, specimens and books and in educational and scientific work. A somewhat insufficient force of gardeners and laborers also has militated against the more perfect maintenance of the older plantations.

The collections are now among the largest and most important anywhere, but their extended usefulness and increase, the further development of the reservation of nearly 400 acres, the completion of the buildings and the extension of educational and scientific work require more funds than as yet have been made available.

Approximately 16,000 kinds of plants have been in cultivation during the year, about 9,000 of which were under glass and 7,000 outdoors. The increase of the record over 1921 is largely covered by the planting in the iris garden and the new rock garden. The garden had the cooperation of the American Iris Society in the work in the iris garden; Mrs. Mortimer J. Fox and T. A. Havemeyer gave their aid in increasing the collections of lilies, Mr. Havemeyer also contributing a valuable series of lilacs. Messrs. Bobbink and Atkins, in continued cooperation with the Horticultural Society of New York, gave 2,700 plants for the rose garden.

In the rock garden the arrangement of gravel and top soil and the planting of over 400 kinds of plants, including over 5,000 individuals, have been largely the work of Dr. E. B. Southwick, custodian of herbaceous grounds.

The rearrangement of the cactus collection and the improvement and development of the southern part of the garden reservation along Pelham Parkway also are dealt with in the report. The latter was carried forward at two points. One of these lies east of the mansion approach entrance, where about 350 feet of the boundary wall and fence have been built. The other area lies between the iris garden entrance and the Bronx River, where some 400 feet of the boundary wall and fence, including piers for the hemlock grove path entrance, built from the bequest of Emma Chambers Jones, grading and drainage have been done and some 400 feet of path system partly built and a screen of trees planted.

Appended reports were made by Dr. H. A. Gleason, assistant director; Dr. John K. Small, head curator; Dr. Murrill, supervisor of public instruction; Kenneth R. Boynton, head gardener; Dr. A. B. Stout, director of laboratories; Dr. Henry H. Rusby, honorary curator of the economic collection; Mrs. N. L. Britton, honorary curator of mosses, and others of the staff.

SCIENTIFIC NOTES AND NEWS

AT the recent meeting of the Geological Society of America, at Ann Arbor, David White, who recently retired as chief geologist of the United States Geological Survey, was elected president. The following vice-presidents were elected: William H. Hobbs, William H. Emmons, T. Wayland Vaughan, Edgar T. Wherry.

PROFESSOR M. F. GUYER, chairman of the department of zoology of the University of Wisconsin, was elected president of the American Society of Zoologists at the recent Boston meeting.

THE Society of American Bacteriologists has elected the following officers for 1923: Professor E. G. Hastings, University of Wisconsin, *president;* Major A. Parker Hitchens, U. S. Army Medical School, *vice-president;* and Dr. J. M. Sherman, U. S. Department of Agriculture, *secretary-treasurer.*

AT the annual meeting of the American Physiological Society at Toronto, December 27, 28, and 29, 1922, the officers elected were: Professor Anton J. Carlson, University of Chicago, *president;* Professor Charles W. Greene, University of Missouri, *secretary;* Professor Joseph Erlanger, Washington University, St. Louis, *treasurer;* Professor Arno B. Luckhardt, University of Chicago, and Professor John R. Murlin, University of Rochester, were elected to the council.

DR. ELSIE CLEWS PARSONS has been elected president of the American Ethnological Society, New York.

SECRETARY HOOVER has designated Dr. Fay C. Brown, assistant director of the Bureau of Standards, to be acting director.

SIR WILLIAM H. BRAGG, Quain professor of physics in the University of London, has been elected a corresponding member of the Paris Academy of Sciences in the section of physics.

PROFESSOR J. SCHUR, mathematician of the University of Berlin, has been elected a member of the Berlin Academy of Sciences.

AS DR. CHAUFFARD, professor of clinical medicine at the School of Medicine, who has been the vice president of the Paris Academy of Medicine, has become president for the year 1923, in accordance with the constitution, the academy has elected Dr. J. A. Doléris vice president. Dr. Doléris is an honorary obstetrician to the hospitals of Paris. The academy also elected Dr. Souques as annual secretary, and Professors Pouchet and Schwartz as members of the administrative council.

RICHARD V. AGETON, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

DR. P. V. WELLS of the optics division of the Bureau of Standards has resigned to take up research work for the E. I. du Pont de Nemours Company, Parlin, New Jersey.

JEROME ALEXANDER, M.Sc., has now an office in the Chemists Building, New York City, as consulting chemist with special reference to colloid chemistry and its applications.

DR. ROBERT M. YERKES, A.M., director of the Division of Personnel Administration of the National Research Council, reported for duty on December 3 to the commanding officer of the Army War College for three weeks' service in connection with army personnel methods. Since Professor Yerkes's discharge from the army he has been a lieutenant-colonel, Officers' Reserve Corps, assigned for duty in case of need to the Division of Operations of the General Staff.

DR. GANO DUNN has been appointed by the council of the Institution of Electrical Engineers of Great Britain to be local honorary secretary of the institution for the United States in the place of the late Mr. George G. Ward.

VERNE L. HAVENS, director of the *Ingenieria Internacional,* has been made permanent secretary of the International Engineering Congress, composed of engineers of North America and the Latin-American republics.

THE Institute of American Meat Packers, Chicago, has appointed a committee consisting of W. D. Richardson, chief chemist, Swift & Company, Paul Rudnick, chief chemist, Armour & Company, and L. M. Tolman, chemical director, Wilson & Company, to select a suitably qualified chemist for the position of director of scientific research of the institute.

DR. BAILEY WILLIS, emeritus professor of geology, Stanford University, sailed for Chile on January 11 to investigate the evidence of the recent earthquake, in response to an invitation sent to the Carnegie Institution of Washington through the Chilean Embassy.

HERBERT E. GREGORY, professor of geology at Yale University and director of Bishop Museum, Honolulu, is returning to Hawaii on February 1 to remain until October.

MR. CHARLES W. HOY, of the Smithsonian Institution, left Washington December 15 for a two years' trip in Central China, in the basin and mountains of the Yang-tse, devoting most of his time to collecting mammals, birds and fishes.

PROFESSOR OSWALD VEBLEN, of Princeton University, has been granted leave of absence for the second semester of 1922-23 and is to spend it in Europe.

DR. WALTER G. CADY, professor of physics at Wesleyan University, has been granted leave of absence for the second half of the academic year. He plans to go abroad visiting laboratories in Italy, France and England.

DR. HENRY B. WARD, professor of zoology at the University of Illinois and national president of the Society of Sigma Xi, recently delivered the annual Sigma Xi lectures at the Missouri and Kansas chapters and at the Sigma Xi Club at the University of Oklahoma, on the following subjects: "The factors which control and direct the migration of the Pacific salmon" and "The struggle of man with the life of the wilderness in North America."

DR. PHILIP A. SHAFFER, professor of biological chemistry at Washington University, will deliver the sixth Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, February 10. His subject will be "Antiketogenesis: its mechanism and significance."

THE Harvard Engineering Society held its annual dinner in New York on February 1 at the Harvard Club. President C. R. Richards of Lehigh University, Dr. Charles P. Berkey, Columbia University, and Albert Palmer, president of the undergraduate section of the society, were the principal speakers.

PROFESSOR M. I. PUPIN, of Columbia University, lectured before the New York section of the American Institute of Electrical Engineers, on January 19, on "The story of modern physics."

PROFESSOR GEORGE C. WHIPPLE, of Harvard University, gave on January 6, 13, 20 and 27 at the Wagner Free Institute of Science four lectures on "The philosophy of sanitation."

DR. A. E. KENNELLY, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology, on January 11, gave a lecture before the Franklin Institute of Philadelphia on "The principles of electrical vibration instruments."

DR. MARSTON T. BOGERT, professor of chemistry in Columbia University, gave a lecture at Connecticut College for Women, New London, Conn., on January 23 on "Synthetic dyestuffs and their bearing on the life of the individual and of the state." Other lectures on science, scheduled for March 20 and 27, are "The pursuit of the atom," by Professor Frederick A. Saunders of Harvard University, and "Psychology and democracy," by Professor Robert S. Woodworth of Columbia University.

A gift of $11,000 has been made to Lafayette College to establish the "Joseph Johnson Hardy Memorial Fund" as a tribute to the services of the late Professor Hardy, for forty-five years teacher of mathematics at Lafayette. The income is to be divided at each commencement equally among the five members of the faculty oldest in point of continuous service, without regard to rank, so long as engaged in full-time teaching.

At the Pasteur centenary meeting held at the New York Academy of Medicine on January 10, the president of the academy, Dr. George David Stewart, announced that the rights to Sacha Guitry's play "Pasteur" have been acquired for Henry Miller. The play will be presented by the Charles Frohman Company, Henry Miller taking the title rôle. The English version of the play has been made by Arthur Hornblow, Jr.

A monument to Pasteur is to be erected at Strasbourg, subscribed by men of science and learning throughout the world. The monument, which is the work of the Lyons sculptor, Larivée, will be placed in front of the university, near that of Goethe. It is an obelisk 10 feet high with a medallion of Pasteur and allegorical figures on either side. The International Exhibition of Hygiene, which is being prepared at Strasbourg, will cover more than 12,000 square yards. Different sections will show the influence of Pasteur's work on the life of man and animals, agriculture and industry. A Pasteur Museum will complete the exhibition.

Dr. John Asbury Elliott, professor of plant pathology at the University of Arkansas and pathologist in the Arkansas Agricultural Experiment Station, died on January 18 at Washington, D. C., where he was expecting to spend the month of January with the Department of Agriculture in plant disease survey work. He died of pneumonia as a complication following bronchitis, contracted while attending the Boston meeting, and was interred at Washington, D. C.

Professor S. S. Keller, head of the department of mathematics of the Carnegie Institute of Technology, died in Baltimore on January 12. Professor Keller had been a member of the faculty of the institute for the past seventeen years.

Professor John W. Caldwell, *emeritus* professor, formerly head of the department of chemistry in Tulane University of Louisiana, died on January 2 at his home in New Orleans.

Dr. John H. Larkin, associate professor of gross pathology at the New York Homeopathic Medical College and Flower Hospital, died on January 17 at the age of fifty-three years.

Dr. K. Kertesz, of the Hungarian Museum, the well-known writer on Diptera and the author of the great catalogue of the Diptera of the world, died on December 28.

The United States Coast and Geodetic Survey has received a cablegram from Leyden, Holland, announcing the death in that city, at a very advanced age, of Dr. H. G. van de Sande Bakhuyzen, formerly director of the Leyden Observatory. For many years Dr. Bakhuyzen was permanent secretary of the International Geodetic Association.

The death is announced of the eminent Italian scholar, Dr. Antonio Nobile Favaro, professor of projective geometry in the University of Padua. Professor Favaro was born on May 21, 1847, at Padua, where also he died on the thirtieth of September, 1922. He is known through the national edition of Galileo's works which he edited in twenty quarto volumes, and by his many historical papers dealing with the life and times of Galileo. Among his most recent contributions is a history of the University of Padua, written for the celebration of the seven hundredth anniversary of this institution, the oldest, not only of the Italian universities, but of all existing universities.

President Harding has withdrawn from settlement three groups of prehistoric towers in southwestern Colorado and southeastern Utah. These are known as the ruins in Ruin

Canyon, Holly Canyon and Cool Spring House on Cajon Mesa. It is proposed that these groups be made a national monument.

The agricultural appropriation bill, carrying $68,981,553, was passed on January 3 by the House of Representatives after Speaker Gillett had thrown out on a point of order a motion to send it back to committee with directions to include $360,000 for congressional free seed distribution.

At the annual meeting in a joint program on the last day of the session of the societies composing the Federation of American Societies for Experimental Biology at Toronto, a very interesting scientific program consisting of ten papers on the newer discoveries of various laboratories in the United States and Canada, led by the laboratories of the University of Toronto, was held on the subject of the pancreas and the specific pancreatic secretion, insulin. At the annual dinner held on the one hundredth anniversary of the birth of Pasteur, December 27, 1922, lectures were delivered on the life and works of Pasteur by the following speakers: Sir Robert Faulkner, University of Toronto; Graham Lusk, Cornell University; Albert P. Mathews, University of Cincinnati; F. G. Novy, University of Michigan.

The Cellulose Division of the American Chemical Society has been authorized as a permanent division of the society and wishes to enroll as members in the division all those who are interested in cellulose chemistry either from a scientific or practical standpoint. All members of the American Chemical Society wishing to become members of this division are requested to send their names and business connections together with one dollar for dues to the secretary, L. F. Hawley, Forest Products Laboratory, Madison, Wisconsin.

UNIVERSITY AND EDUCATIONAL NOTES

Plans for a new chemical laboratory for the Johns Hopkins University, to be erected at Homewood, at a cost of about $600,000, have been completed. The details of the building have not been made public, but it is known that the type of architecture will conform to the colonial style of the Homewood group. Bids for contracts for the new $1,000,000 home of the Johns Hopkins School of Hygiene and Public Health, which will be on Monument and Wolfe Streets, as a part of the hospital group, will shortly be asked. The plans have been completed. This structure will be of Italian architecture of brick and stone, and is provided through a donation to the school by the Rockefeller Foundation.

A fund amounting approximately to $3,800 has been subscribed in honor of Professor Appleton, of Brown University, to be known as the John Howard Appleton Lectureship Fund to provide annual lectures at Brown on pure or applied chemistry.

Brown University has received $50,000 from the estate of the late Robert P. Brown, to endow a professorship in biology. Albert Davis Mead, head of the department of biology in the university, has been appointed Robert Perkins Brown professor of biology.

Dr. Harry Pratt Judson, second president of the University of Chicago, holding that position for sixteen years, has resigned and will retire from active work on February 20. Dr. Ernest DeWitt Burton, head of the department of New Testament and early Christian literature and director of the libraries, has been elected acting president.

Thomas B. Bains has accepted a position as assistant professor of mining engineering at the University of Illinois.

Herbert R. Hanley has been appointed associate professor of metallurgy at the Missouri School of Mines.

DISCUSSION AND CORRESPONDENCE

BALANCING CHEMICAL EQUATIONS

In the issue of Science for September 1 (page 258) there is an article describing an algebraic method of balancing chemical equations. The method, which assumes a knowledge of the formulas of the initial and final substances, consists in finding, algebraically, sets of values for the coefficients of the equations. The author seems to have discovered a nearly constant relation between the number of elements and of compounds represented in the equation. To the writer the ratio does not seem to hold very strictly even in the equations cited in the articles; but this may be due to a lack of understanding on his part. When understood it may be assumed to be accurate, and may be useful and rapid in the hands of those whose minds readily run along mathematical channels. It may also be advantageous in commercial laboratories, where the end sought is simply the relative weights of materials taking part in reactions because, being mathematical, it suggests an element of certainty to the conclusions. It may be especially useful in those commercial laboratories where the workers have only a superficial knowledge of the principles underlying chemical changes and therefore can not, with certainty, apply chemical methods of balancing.

But where the end sought is a clear understanding of the principles of the subject the method described has in it, as in all mechanical methods, an element of danger, since it may lead the worker to the belief that the balancing of an equation is, *per se*, proof of a thorough understanding of the chemistry involved. To the writer it still seems uncertain whether the newer algebraic method has any advantage, either in certainty of conclusion or in rapidity of work, over the strictly chemical method of balancing. A comparison of the two methods may be made by considering the first equation introduced by the author of the article in question, *viz.*, the reduction of silver arsenate by the hydrogen produced by the action of zinc with sulfuric acid:

$$aAg_3AsO_4 + bZn + cH_2SO_4 \rightarrow$$
$$dAsH_3 + eAg + fZnSO_4 - gH_2O.$$

Since the equation shows that the salt is reduced to silver and arsine, it takes but a glance to see that for each molecule of the salt there is needed sufficient hydrogen (8 atoms) to combine with the four atoms of oxygen (forming 4 molecules of water) and additional hydrogen (3 atoms) to combine with the arsenic (forming one molecule of arsine). That is, 11 atoms of hydrogen are needed for each molecule of the salt. Since an odd number of atoms of hydrogen can not be made by the action of sulfuric acid on zinc the one molecule of salt must be multiplied by two, and these require 22 atoms of hydrogen (from 11 molecules each of zinc and sulfuric acid) and there are produced 6 atoms of silver, 2 molecules of arsine and 8 molecules of water. Thus the smallest coefficients necessary to balance the equation are easily found, and there is the added advantage that the principle and mechanism of the reaction are reviewed.

The other illustrations used by the author are as easily analyzed and balanced if there is kept in mind the additional thought that the salts behave as though they were composed of two oxides each ($2KMnO_4 \rightarrow K_2O, Mn_2O_7$ and $K_2Cr_2O_7 \rightarrow K_2O, 2CrO_3$), the latter oxide in each case being reduced to the lowest oxide. Finally all the oxides react with sulfuric acid to form sulfates.

In detail, two molecules of the permanganate must lose 5 atoms of oxygen and these combine with an equal number of atoms of the oxygen from 5 molecules of the hydrogen peroxide, forming five molecules each of oxygen and water. The three molecules of oxide ($K_2O, 2MnO$) then react with three molecules of sulfuric acid to form one molecule of potassium sulfate, two molecules of manganese sulfate and three additional molecules of water (eight in all). The equation can then be written with the proper coefficients.

The reduction of the dichromate is more complicated only in this, that two reducing agents are involved, both of which are assumed to be oxidized—an assumption which probably would not be verified by experiment.

This note is written, not to criticize the algebraic method of balancing equations, but rather as a caution to teachers (especially young and inexperienced teachers) and students who might adopt it as a means of partially solving a rather difficult teaching problem—the writing of equations. It might be a help in solving this problem, but only at the expense of most important and vital teaching points; for the proper writing of equations is not an end in itself, but only a means of enforcing important chemical facts and principles, of studying the mechanism of reactions, and of practicing clear chemical thinking. All mechanical methods of balancing equations disregard these important elements in education.

James H. Ransom

Decatur, Illinois

A "SPINDLING-TUBER DISEASE" OF IRISH POTATOES

INVESTIGATIONS by the writers have recently disclosed that a malady commonly designated as "running-long" or "running-out" is an infectious disease. It has been transmitted from diseased to healthy plants by means of tuber grafts, vine grafts, leaf-mutilation inoculation and plant lice. Proximity of healthy plants to diseased plants in the field increases the amount of infection. The tubers perpetuate the disease from year to year. In the absence of control measures the percentage of incidence in a given stock increases from year to year.

Plants infected late in the season may show no symptoms in their tubers or elsewhere. Plants infected early from the seed-tubers or otherwise have erect, spindling stalks, leaves that are smaller, more erect and often darker green than healthy foliage, and tubers generally more cylindrical, more spindling, more spindle-shaped and with more numerous and more conspicuous eyes than are the tubers from healthy plants or from plants apparently healthy but inoculated late in the season. The yield is reduced somewhat the first year in which the symptoms appear in the plants, and more in subsequent years from plants growing from spindling tubers. In view of the symptoms described, the term "spindling-tuber disease" is proposed.

Like other degeneration diseases of potatoes, this disease has been attributed in the past to senility, reversion and adverse conditions of weather, climate, soil and culture. Undoubtedly potato tubers often are poor-shaped because of other causes than this disease. It is also clear that diseased hills may produce some tubers not easily distinguished from commercially acceptable tubers. However, many of the losses due to poor tuber shape and to reduction in yield are to be attributed to the spindling-tuber disease, which is to be found in many varieties and in all percentages of incidence.

More detailed data on this and other degeneration diseases of the potato are being prepared for publication in a later paper.

EUGENE S. SCHULTZ
UNITED STATES DEPARTMENT OF AGRICULTURE
DONALD FOLSOM
MAINE AGRICULTURAL EXPERIMENT STATION

NICOTINE SULPHATE, AN EFFECTIVE VERMICIDE FOR SHEEP

EXPERIMENTS covering a period of three years of study on the control of the sheep stomach worm, *Hæmonchus contortus*, at the Storrs Experiment Station have resulted in the finding of an effective dosage for killing stomach worms.

The most effective agent used has been a 40 per cent. nicotine sulphate diluted with water. Ten cubic centimeters, or approximately two teaspoonfuls of the 40 per cent. nicotine sulphate in one quart of water, giving four ounces to adult sheep and two ounces to lambs. These treatments were used in 948 cases, and 161 animals have been slaughtered twenty-four hours after the treatment and only a few live worms have been found in the stomach, constituting an effective dosage in that thousands of worms are commonly found in a single stomach.

The treatment caused the death of five weak lambs. While the treatment staggers and even kills very weak animals, it can be used without danger to other sheep and lambs and one can be reasonably sure of the effectiveness of the treatment in contrast with the less efficient copper sulphate treatment that has been so universally recommended. In the experiments where the one per cent. copper sulphate was used, live worms were found in the stomach and stronger solutions caused severe burns. In cases where the three per cent. copper sulphate solution was used as a dosage, the mortality from the treatment was more than sixty per cent.

Twelve hours previous to the treatment, the animals were kept away from food.

GEORGE H. LAMSON, JR.
STORRS EXPERIMENT STATION

SWARMING INSECTS SIMULATING SMOKE

ON February 26, 1921, at 6:30 P.M., persons strolling about the main building of the University of Texas raised a fire alarm because of what appeared to them as a wreath of smoke issuing from the middle tower. The writer was unable to discover any fire within the tower but from the roof of the building could make out that the "smoke" consisted not of carbon particles but of insects. These were issuing from a small hole under the tin and flying in a close swarm, gently blown back and forth in the breeze like a delicate streamer. The swarm played in this manner for about fifteen minutes and then seemed to return whence they came.

None of the specimens were recovered from this swarm, but there seemed to be no doubt that they were Tenebrionid beetles living in bat guano in the tower. The insects secured from the bat guano this year were kindly identified by Dr. Edwin C. Van Dyke as *Blapstinus pratensis*, Lec.

In this connection the following Associated Press dispatch as published in the Austin *American* June 5, 1922, is of interest:

> Chicago, June 4.—Mosquitoes flying in such thick swarms that they were mistaken for smoke caused two fire alarms to be turned in early to-day.
>
> Members of a truck company answered a call saying that the steeple of St. Michael's Roman Catholic Church was burning. The firemen saw what they at first supposed was a small cloud of smoke and they raised their extension ladders to fight the fire. When they mounted the ladder they encountered mosquitoes and were forced back. The same experience was met by members of another engine company called to the Zion Methodist Church in another part of the city.

The fact that these two swarms were encountered the same day gives ground for the suspicion that guano beetles, not "mosquitoes," were swarming from bat-infested belfries of the two churches. The participation of the majority of the members of a species in the same locality on the same day of the year is, of course, a common phenomenon. If this were not so, swarming as a reproductive function would lose its adaptive significance.

Carl Hartman

The University of Texas

QUOTATIONS

A SUPER-UNIVERSITY

The meeting of the American Association for the Advancement of Science in Cambridge fulfills in a way the vision which Franklin K. Lane had of a "super-university." In a letter written in his own hand on the day before he went on the operating table in May of 1921, he described this "place of exchange for the new ideas that the world evolves each year" as follows:

> No faculty—but a super-university with all the searchers and researchers, inventors, experimenters, thinkers of the world for faculty. No students—but every man the world round interested in the theme under consideration welcome as a student without pay.

Except that the meeting in Cambridge was national in its personnel, it answered very well Mr. Lane's definition. Nearly all the departments of human knowledge were represented: chemistry, botany, anthropology, mathematics, physics, geology, geography, zoology, agriculture, psychology and the economic and social sciences. Those not included were represented in like meetings elsewhere. A thousand papers were presented, from Professor Edmund B. Wilson's on "The physical basis of life" and Dr. Bell's discussion of the smashing of atoms to a study of baldness and of the ideal stature of successful salesmen. Every paper meant research into the field of the unknown in man's environment and most of them pushed back by much or little the mystery that surrounds his existence or made friends for him of forces that before seemed hostile to his freedom or his life.

This meeting also gave the super-university "Faculty"—serving for very love of the truth itself in most cases—an audience that was generally competent to understand what was brought before it. And when the results are intelligently, intelligibly and accurately reported, as was done by the *Times*, the student body becomes larger than that of any university, larger even than that of the super-university conceived by Mr. Lane.

There is only one thing lacking, and that is a permanent exhibition of the yearly increments made by man's conquest of his environment so that the public may have an opportunity to see (so far as it can be visualized) "all that is new in science, philosophy, practical political machinery and all else of the world's mind products." If there could be a place for such permanent exhibition and illustration of the contributions for the year of scientific research and experiment and invention (and "why not in New York?" said Mr. Lane), the value of such meetings as that at Cambridge and in other parts of the world would be vastly increased.—*The Times*, New York.

PROBLEMS IN THE DETERMINATION OF PHYSICAL PROPERTIES

In preparing for publication the data on physical properties of chemical substances, the editorial staff of *International Critical Tables* will find from time to time that important physical properties of substances of technical and scientific importance are missing from the literature. As fast as we become aware of missing data of this character, it is our policy to formulate research problems covering such missing data and to endeavor to interest chemists and physicists in undertaking the necessary investigations to supply the required data.

Most of the research problems formulated in this way will be suitable for bachelors' or masters' theses and in a few instances topics sufficiently broad to be suitable for doctors' theses will also be available. Many of them will be suitable for experimental problems in the ordinary laboratory courses in physical chemistry and physics. Thus, for example, the laboratory experiment covering the determination of solubility might to advantage deal with substances whose solubility is needed but is unknown. The average of the determinations made by a class of students, while not as accurate and reliable as the determinations made by a skilled investigator, will nevertheless be very valuable when they constitute the only data available on the subject. Moreover the average student will be more interested in a laboratory experiment the results of which are of actual value and worthy of publication than he would be in repeating for the *n*th time the measurement of a property of some system which has been measured many times before.

International Critical Tables will be glad to submit to interested instructors in universities and colleges lists of problems of this character and to advise as far as it can concerning suitable apparatus and methods of measurement. It may be possible also in some instances to secure moderate financial assistance to aid in the purchase of materials and apparatus for investigators interested in carrying out work of this character. The results of such work may be published by the investigator in any appropriate publication medium and they should also be reported in duplicate to the office of *International Critical Tables* on completion of the work.

A number of problems on the following subjects are available at the present date: Heats of combination: solid oxides; Fe compounds. Specific heats: brass; solid oxides; steels; oils and fats; petroleum products; metals; salts; Fe compounds; asphalts. Latent heats of fusion: brass; metals. Heat conductivity: steels. Latent heats of vaporization: petroleum products. Viscosities: industrial materials; solutions. Kinetics: rates of drying; hydrolysis of industrial materials; catalysis; transpiration of moisture; biochemical. Strength: industrial materials. Thermal expansion: steels; Fe compounds. Freezing-point-solubility diagrams: salts; acids; metals in water; soaps. Boiling points: solutions. Solubility of gases: in molten metals; in water. Chemical equilibrium; dissociation pressures at 1600° C. Electrical conductivity: metals; refractories. Properties of colloidal systems; industrial materials. Vapor pressures: metals; solutions. Specific rotatory power: gliadin. Index of refraction: solids. Density: certain organic compounds; solutions. Flash points. Surface tensions: solutions.

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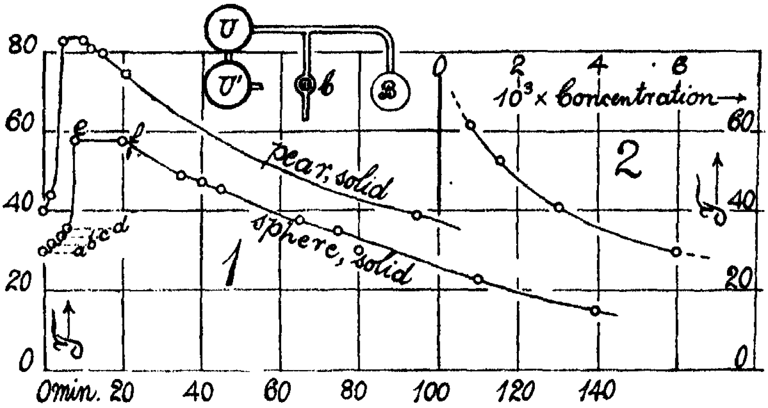
SPECIAL ARTICLES

GLUE BUBBLES

1. *Introductory.* The improvements which I have recently given to the interferometer U-gauge adapt it for measurements throughout larger intervals. The apparatus requires some experience on the part of the operator, but it gives absolute pressure values directly, and is quite robust, if not abused. Adding the pin hole valve as heretofore, I detected a hysteresis-like phenomenon in the telephone, according as an intermediate intensity of sound was reached from increasing or from decreasing intensity.

But the chief promise which the interferometer U-gauge seems to hold out is the measurement of such small but persistent pressure increments as arise in certain chemical and bacteriological processes. Here, how-



ever, one is liable to be misled by the inseparable temperature effect. For when one shank of the U-gauge is closed, it becomes an air or vapor thermometer, responding to much less than .001° C. per fringes. Hence though I ventured at some length upon experiments on gas absorption, vapor diffusion and solutional effects, it became increasingly obvious that the pressure increments and decrements obtained in a heated room were not trustworthy. I shall resume the work in the summer.

2. *Bubbles in general.* In case of bubbles of any kind (see diagrammatic insert, U-tube *UU'*, cock *C*, bubble *B*), these annoyances fall away and the pressure increment within the bubble is adjusted by the liquid film itself. It is of interest, therefore, to measure from pressures within the surface tension *T* of such films, passing by evaporation continuously from the liquid to the solid states. Of course, when the latter is reached, the bubble is no longer contractile and *T* ceases to be measurable; but one may at least reach a high state of viscosity. I have worked with sugar solutions, molasses and glue. In the former case, persistent bubbles are not producible; but by adding a drop of commercial soap solution to 10 cm.^{3} of sugar solution (1 gram in 10 cm.^{3}), bubbles 2 cm. in diameter or more are obtained. Occasionally one persists and dries out to a smooth, iridescent bubble of solid sugar, which may be detached and preserved. Again the sugar solution (or better plain distilled water) with one drop of liquid soap may be successively diluted, until the surface tension of pure water is closely approached. I passed in this way from *T* below 30 to *T* above 60 and could have gone further. It is interesting to note that when *T* is high, it rapidly falls off to lower values, possibly from the contamination of the surface of the film on exposure, but more probably, as I think, from the marshalling of the remaining colloidal molecules at the surface, with expenditure of potential energy.

3. *Glue bubbles.* These (common liquid glue diluted 5 to 10 times) are obtainable directly, since a diameter of 2 cm. or less is adequate. Nevertheless, if the mixture were expensive, the inevitable waste would be prohibitive. Fortunately it is not, and all that need be expended is patience, which is cheap. As above, bubbles are sometimes obtained which actually last indefinitely and these solid glue bubbles may be ultimately detached. I give the time record for two of them in Figure 1, in which surface tension *T*, is exhibited in the lapse of minutes. In the first of these the drop at the bottom of the bubble dried without further distortion, the bubble remaining spherical. In the second the drop blew itself out further and the bubble became symmetrically pear-shaped. In the case of the sphere, *T* at the beginning increased in *stages* shown at *a*, *b*, *c*, *d*, *e*, in the figure, the interval of persistence from *a* to *d* being less and less prolonged, while *e* is permanent. One would be inclined to consider these steps as successive phases passed through on the way to solidification; but the mottled color patterns on the bubble show that at most a complex of phases are temporarily in equilibrium. At *f*, after about 20 minutes, *T* apparently begins to decrease regularly.[1] It is obvious, therefore, that at *f* the bubble is practically solid, that most

of the water is gone and the compressed air within is now following, diffusing outward through the meshwork of colloidal molecules. The apparent decrease of T is thus spurious, merely implying that the solid bubble is continuous but leaky. This may be tested by opening the stopcock. After 4 hours no internal pressure is left. In case of the pear shaped bubble, the phenomenon was like the preceding, but much more rapid, so that stages of T could not be recognized. The T reached by the nearly solid bubble is very high, but a part of it must be referred to the change of shape specified.

In figure 2, I have shown the result of the successive dilution of the original liquid glue. The surface tension remains low and nearly constant until a dilution of the order of .005 is reached. Thereafter, with further dilution, T increases very rapidly to above 60 in the figure. Using the last (dilute) solution about a week later, bubbles were no longer obtainable, even after warming. Adding a drop of dilute soda solution, however, restored its bubbling virtue. On successive dilution by halving, this gave (in mean values) $T = 52$, 59, 63, 68, 73. With two observers, one to measure the diameter of the bubbles and the other to manipulate the interference fringes, even closer approach to a water surface would be possible. Though thick and colorless, the bubbles have to withstand an increasing capillary strain and like time and tide they tarry for no man.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION G—BOTANICAL SCIENCES

Vice-president and chairman, Francis E. Lloyd.

Retiring vice-president, Mel. T. Cook.

Secretary, Robert B. Wylie; State University of Iowa, Iowa City, Iowa.

(*Report by R. B. Wylie*)

From the viewpoint of the botanists the Boston meeting was one of the best in recent years. While the number of members in attendance from the interior and from the west was somewhat smaller than at the Chicago meeting, there were proportionately more of the eastern workers in attendance. The botanical programs presented an imposing array of titles. Something over two hundred papers and addresses were scheduled in the various meetings for plant workers.

The extent of the program as well as diversity of interest compelled two or more series of botanical papers at each session. The efficient messenger system, however, readily enabled all to know the progress of all programs so that papers of special interest, though in different rooms, could readily be heard unless they actually conflicted in time.

An examination of the content of the botanical programs offered by the different sections of the affiliated societies shows a tendency towards greater variety than formerly. The strict categories are breaking down, along certain lines at least, and it often happens that a given paper may very properly be classified or presented in two or more sections. This may be due to broader interest or better training of the present workers, but primarily to the growing appreciation of the interdependence of the several fields of plant science.

In a still larger sense the boundaries between zoology and botany as a whole are becoming rather shadowy in many places, and the physiologists, geneticists and ecologists properly pass from one class of material to another and follow both sides with keener interest. These facts bespeak the need for large scientific meetings where members of the several sciences may hold programs in parallel series with greater profit to all concerned. Though emphasized elsewhere, it may be repeated here that modern buildings such as those at the Massachusetts Institute of Technology afford ideal conditions for holding such meetings as those recently held in Boston.

The invitation program of Section G was held on Wednesday afternoon as a joint session with the Botanical Society of America and the American Phytopathological Society. The program, which was attended by a large number of botanists, included the address of the re-

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[1] Even at e the evidence of increasing T may be masked by the incipient solidification.

tiring vice-president, Mel. T. Cook, on "The original development of plant galls," and a symposium of four papers dealing with certain aspects of sterility in plants. In his address, Mr. Cook discussed the ontogeny and phylogeny of plant galls, their relations to the causal organisms and factors, together with practical considerations of their economic importance. In the symposium, Dr. A. B. Stout's paper, read by Professor R. A. Harper, discussed the cultural and experimental aspects of sterility from a physiologist's viewpoint. Professor Bradley M. Davis analyzed the bases of sterility, taking up both pollen and seed sterility, and calling attention to another type of sterility due to weak and inefficient seedlings. Cross and self sterility in their genetical bearings were taken up by Dr. E. M. East, who discussed the causes and control of pseudo-fertility, together with the mutual and reciprocal relations of self-sterile strains. Dr. M. J. Dorsey, in taking up the relations of sterility to horticulture, dealt with the status of sterility in cultivated plants, especially in relation to the environmental influences, and other problems related to the practical handling of cultivated plants.

During the autumn the Section Committee balloted by mail, and following their nomination, C. J. Chamberlain was elected vice-president for Section G, and R. A. Harper as member of the Section Committee.

On Thursday evening occurred the dinner for all botanists, following which was given the address of the retiring president of the Botanical Society of America, Dr. C. E. Allen. In his address Dr. Allen dealt with the potentialities of the plant cell as expressed in its structural and functional specializations. Other speakers on the program discussed the need of a tropical research laboratory, and the present status of *Botanical Abstracts*.

THE BOTANICAL SOCIETY OF AMERICA

President, Henry C. Cowles.

Secretary, Ivey F. Lewis, University of Virginia, University, Va.

(*Report by I. F. Lewis*)

The seventeenth annual meeting of the Botanical Society of America was held in affiliation with the American Association for the Advancement of Science at the Massachusetts Institute of Technology on December 27, 28 and 29.

Officers were elected as follows: *President,* B. M. Duggar; *vice-president,* J. R. Schramm; *secretary,* I. F. Lewis; *treasurer,* I. W. Bailey; *editors, American Journal of Botany,* William Crocker, R. A. Harper, Donald Reddick; *representative, division of biology and agriculture, National Research Council,* J. M. Coulter.

For the first time in the history of the Society "corresponding members" were elected, these being Hugo De Vries and F. O. Bower.

Formal approval was given to the project to establish in Washington a national arboretum and garden, and cooperation was promised the Botanical Society of Washington to bring this about.

The annual dinner for all botanists was held on Thursday evening. President H. C. Cowles presided. After short talks by Dr. A. S. Hitchcock, Dr. William Crocker, and Professor B. M. Davis, the retiring president, Dr. C. E. Allen, delivered the annual address on "The potentialities of a cell."

The Society met with the New England Botanical Society on Friday evening at the home of the American Academy of Arts and Sciences.

General Section

(*Report by John T. Buchholz*)

In a brief discussion, A. J. Eames, of Cornell University, called attention to the remarkable uniformity in vascular anatomy of the nodes of plant stems, suggesting how the facts of plant anatomy may be used in solving the puzzles of the relationships of plant orders and families. Carpels have three bundle traces without known exception, while stamens have only one bundle trace, this being derived from three. Since petals have only one trace a majority of them are stamens, while sepals are bracts or leaves in origin. The fact that gymnosperms have only one or two traces, never three, suggests that angiosperms are an isolated group and were not derived from known gymnosperms.

As an illustration of the use which may be made of vascular anatomy in solving problems of relationships, Dr. Eames presented a paper by Miss Mary Jones Fisher, in which the morphology of the flower of willows was investigated. This work in vascular anatomy shows that the floral parts of willows have suffered a reduction, having been derived from a more highly specialized insect pollinated flower. They are therefore specialized groups rather than primitive plants, as looked upon at present by taxonomists.

Miss Alma G. Stockey, of Mt. Holyoke College, announced the discovery of the prothallium of *Lycopodium obscurum*, and exhibited living specimens of these gametophytes with young sporelings.

The structure and development of the polycladous form of *Sphærocarpus Donellii* was described by Alfred M. Wolfson, of the University of Wisconsin. This liverwort is also being investigated by C. E. Allen and his coworkers for the heredity of this character, this phase of the work having been reported by Dr. Allen before the Joint Genetics Section.

E. C. Jeffrey, of Harvard University, presented some new evidence that the crystals of Ginkgo are extracellular. His statement that the protoplast of these crystals together with its nucleus is entirely within the crystal brought forth a sharp discussion in which skepticism was expressed on the question of whether these observations were correctly interpreted, while Dr. Jeffrey indicated with no hesitation that he accepted the challenge to prove this point.

P. C. Mangelsdorf, of the Bussey Institution, described the nature of a number of endosperm anomalies in maize, some of them involving almost complete absence of endosperm.

That color inheritance in maize endosperm is an exceedingly complex problem was indicated by R. A. Harper, of Columbia University, who exhibited color plates showing a wide range of colors produced in the F_1 generation when certain strains are crossed, though the parent strains had been inbred for many generations. It has been generally accepted that all F_1 hybrids between highly inbred strains are similar.

Michael Levine, of New York City, who has been studying plant gall tissue in comparison with animal cancers, pointed out some important differences in these neoplasms. He explained that in animal cancers many cells go into division simultaneously, while in plants these cell divisions are uneven.

J. D. Hale reported that true bars of Sanio are found only in the secondary wood and are of diagnostic importance in relation to the groups in which they occur. In another paper, Mr. Hale interpreted the trabeculæ of Sanio as arising through fungal infection of the cambium and that they are associated in a radial series of locally depressed annual rings. J. D. Hale and M. J. Brophy reported that the strength of timbers varies with the rate of growth and is correlated with definite morphological characters.

R. H. Wetmore in tracing the evolution of lenticels showed that whereas in primitive forms they were related to appendages in higher type they are correlated with the rays. A. E. Longley in studying pollen development found but four out of thirty-seven forms of *Rubus* with normal pollen production and an even higher degree of irregularity in *Cratægus*, suggestive that most of these forms are of hybrid origin.

A study of traumatic tissue by A. E. Longley strengthens the hypothesis that the pines stand in a primitive position in the Abietineæ, rather than as reduced forms.

Physiological Section

Chairman, William Crocker.

Secretary-treasurer, R. B. Harvey; University of Minnesota, University Farm, St. Paul, Minn.

(Report by R. B. Harvey)

The program of the Plant Physiologists consisted of three general sessions and two symposia. The 29 papers presented in the general sessions displayed greater interest in plant physiological problems than has been shown at any previous meeting. Papers on salt absorption and general nutrition occupied the major part of the Wednesday morning and the Friday afternoon sessions. Papers relating to permeability and oxidative changes were given on Friday morning. Among the papers given at this session there was presented a method for determining the oxygen-supplying power of the soil, a factor which is of much importance and which has been difficult to determine. At the symposium on "Mosaic diseases," held in joint session with the American Phytopathological Society, the contributions on this subject mark an epoch in the study of these important diseases. The symposium with Section C (Chemistry) held Thursday afternoon, on photosynthesis and photochemical reactions, attracted much attention; it was a very thorough and complete presentation of the problems related to photosynthesis. The discussion covered the general nature of photochemical reactions in plants, in particular, and the physiology and chemistry of the utilization of the assimiliate. The program was of great interest throughout, although unusually long.

The following officers were elected: *Chairman,* Professor Lewis Knudson; *vice-chairman, Pacific Section,* E. T. Bartholomew, R. B. Harvey; *secretary-treasurer,* R. B. Harvey.

Mycological Section

Chairman, C. L. Shear.

(*Report by C. L. Shear*)

Two sessions of the Mycological Section of the Botanical Society of America were held, at which 19 papers were presented. About 50 members were in attendance.

R. H. Colley and Minnie W. Taylor discussed peridermia of five-needled pines, pointing out that there are two other species besides the one belonging to *Cronartium ribicola* which are very closely related to it but distinguishable by certain spore characters. Dr. Colley also discussed methods in spore measurement, pointing out the necessity for standardizing our methods of measuring spores so that the results of different workers may be comparable.

H. S. Jackson and E. B. Mains discussed *Aecidium Myosotidis* Burr., a rather rare species which is connected with telia on grasses. Dr. Jackson also gave observations on the Micro-Puccinias, pointing out the remarkable similarity between the telia-spores of certain short-cycled forms and long-cycled forms on the same host.

B. O. Dodge discussed the morphology and host relations of *Pucciniastrum americanum,* a rust of red raspberries which was rather severe in a plantation near Washington the past season. Dr. Dodge also discussed the systematic infection of species of Rubus with the orange rusts, showing how and when infection occurs, and that systematic infection can be easily demonstrated by microscopic examination of sections of roots or stems.

F. D. Fromme gave a description with illustrations of an undescribed species of rust on the cow-pea. This is closely related to, and has been confused with other common rusts on closely related plants.

E. M. Gilbert read a paper on cytological studies of some uredineæ, discussing the nuclear behavior in short-cycled puccinas on Circææ and from Cryptotænia.

S. A. Wingard read a paper on nuclear phenomena in ascospore formation of a parasitic yeast, tracing the development of the ascospores in a remarkable fungus which has been found parasitic on lima beans.

In a paper by Leva B. Walker, giving observations on the development of *Endogone malleola,* the morphology of this rather rare fungus was described as it appears in pure culture and in nature.

Cultural studies of *Armillaria mellea* Fr. and *Clitocybe monodelpha* Morg. were presented by Miss C. Audrey Richards. The close similarity in appearance of pure cultures of these two fungi was pointed out, and the slight difference in the Armillaria taken from different hosts were shown.

J. J. Taubenhaus and D. T. Killough presented recent advances in our knowledge of Texas root rot of cotton, *Ozonium omnivorum,* describing successful inoculation experiments not previously reported and giving data relating to the mode of over-wintering of the fungus in the field.

The physiology of perithecia formation in *Valsa leucostoma* was given by Leon H. Leonian. It was shown that the formation of pycnia and perithecia could be controlled by variations in the nutrient media and by transfers to media of different composition.

Michael Levine gave results of further study on the behavior of crown gall on the rubber tree, *Ficus elastica,* showing the effect upon plants in which the tips had been killed by the gall organisms.

C. L. Shear in a paper on Phoma—as a sample of mycological nomenclature and classification—pointed out the great confusion which now exists in the application of this name and the wide departure from its original usage by its author, Fries, as a monotype genus, showing the need of fixing generic names by the application of the type method.

Margaret B. Church and Charles Thom discussed the relation of commensalism in common molds to taxonomy, pointing out the confusion which sometimes arises from the fact that certain molds frequently grow in such close association in culture that they are easily confused.

A preliminary note on the peculiar marine phycomycete, Coenomyces, by I. F. Lewis and W. H. Weston, Jr., was presented by Dr. Weston. This peculiar and interesting fungus has not heretofore been reported except from Russia.

David H. Linder reported on a Rhizopogon new to the eastern United States. The fungus appears to be a species identical with one from California.

H. M. Fitzpatrick gave an outline of a monograph of the genus Nitschkia and related genera, indicating his proposed method of treatment of the group.

Dr. W. H. Weston, Jr., of Harvard University, was elected chairman of the section.

Systematic Section

Chairman, M. L. Fernald.

Secretary, Alfred Gundersen, Brooklyn Botanic Garden, Brooklyn, N. Y.

(*Report by Alfred Gundersen*)

Two sessions were held and fourteen papers presented. On Thursday F. W. Pennell presented evidences of parallel lines of evolution in *Afzelia.* M. L. Fernald, speaking of the flora of eastern Canada, concluded that no fundamentally distinct species had evolved there since the glacial periods. Miss A. Brackett compared seeds and floral characters in *Hypoxis.* W. W. Eggleston presented researches on *Zygadenus.* N. C. Fassett spoke on estuary floras. C. O. Rosendahl described two new species of *Sullivantia,* his paper being read by Mr. Butters.

At the session on Friday, P. A. Rydberg proposed dividing the *Galegeæ* into eleven subtribes instead of five. A. S. Hitchcock spoke on the type-basis code, a modified form of the American code. Alfred Gundersen presented a diagram of orders of dicotyledons. A. J. Eames and P. A. Rydberg discussed the nature of epigynous flowers. I. M. Johnston spoke on the fauna and flora of southern Lower California, concluding that the fauna has a northern and the flora a Mexican origin. B. L. Robinson urged the need of greater monographic activity in America, as contrasted with regional investigations.

Following the reading of papers, John H. Schaffner, of Ohio State University, was elected chairman for 1923, and Alfred Gundersen was reelected secretary.

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

President, E. C. Stakman.

Secretary, G. R. Lyman, U. S. Department of Agriculture, Washington, D. C.

(*Report by F. D. Kern*)

The program for the Boston meeting of the American Phytopathological Society included eighty-nine papers. In addition two sessions were in the nature of conferences at which formal papers were not presented. Most of the papers were presented, but a few authors, as usual, sent titles without any provision for their presentation. The custom of publishing the abstracts so that each member may have a copy at the meeting was continued this year. There was but a single session at which miscellaneous papers were read. Special sessions were as follows: Mosaic diseases, diseases of fruits and trees, diseases of potatoes and truck crops, diseases of cereals, a conference on potato inspection methods, a round-table discussion on extension methods as applied to plant pathology, a joint session with the American Association of Economic Entomologists on plant quarantines, and a joint session with Section G and the Botanical Society of America in which the address of the retiring vice-president, Mel. T. Cook, of Section G, was on a pathological topic, "The origin and structure of plant galls."

Without doubt the most important section of the program was that dealing with mosaic diseases of plants, a joint session with the Physiological Section of the Botanical Society. The most striking contribution, and one that marks a great step forward in the science of phytopathology, was a demonstration of the occurrence of protozoans in plants affected with mosaic and related diseases. In the mosaic of tomato, bean and clover, and also in potato leaf roll, Ray Nelson demonstrated in longitudinal sections the presence of biflagellates and trypanosomes. Kunkel and McKinney, Eckerson and Webb made contributions concerning the presence of intracellular bodies in mosaic tissues of *Hippeastrum* and in rosette of wheat. The distribution of both the flagellates and intracellular bodies in the host tissues and their frequent application to the host nuclei further indicate their association with mosaic-like diseases. Other papers presented facts concerning the conditions which lead to the masking of mosaic and leaf-roll of potato in certain northwest areas and at high altitudes. Another paper dealt with the specificity of six mosaic-like diseases of the potato. The eradication of the perennial weed hosts as a means of control in tomato mosaic was the topic of another paper. Altogether fourteen papers on mosaic were presented.

In a paper on crown-gall, Riker presented evidence to the effect that the bacteria exert their influence from an intercellular rather than intracellular position.

Several papers were presented extending our knowledge of biological specialization in the cereal rusts. Evidence was presented in one paper indicating that dust for stinking smut of wheat is a promising method of control.

Two papers presented new facts concerning apple blotch control; four papers contributed further information concerning white pine blister rust both in America and Europe; two papers reported progress and methods of barberry eradication; and six papers referred to various phases of the cereal-fusarium problem.

The round-table discussion on extension work in plant pathology was the first session of this kind that has ever found a place on our program.

The success of this session emphasizes the interest in this subject, and indicates that future annual meetings must provide opportunity for similar discussions.

The symposium on plant quarantines, in joint session with the American Association of Economic Entomologists, was of great importance in that it outlined the history of plant quarantines, summarized our experience to date and permitted discussion of future plans.

The officers of the American Phytopathological Society for 1923 are as follows: *President*, G. R. Lyman, West Virginia College of Agriculture, Morgantown West Virginia; *vice-president*, F. D. Fromme, Virginia Polytechnic Institute, Blacksburg, Virginia; *secretary-treasurer*, R. J. Haskell, U. S. Department of Agriculture, Washington, D. C.; *additional members of the council*, I. E. Melbus (College of Agriculture, Ames, Iowa), M. F. Barrus (College of Agriculture, Ithaca, N. Y.), E. C. Stakman (*ex officio*) (University of Minnesota, St. Paul, Minn.), Perley Spaulding (*ex officio*), (U. S. Department of Agriculture, Washington, D. C.), W. P. Fraser (University of Saskatchewan, Saskatoon, Saskatchewan, representing the Canadian Division), F. D. Heald (State College of Washington, Pullman, Washington, representing the Pacific Coast Division), L. R. Hesler (University of Tennessee, Knoxville, Tenn., representing the Southern Division).

THE SULLIVANT MOSS SOCIETY

President, A. LeRoy Andrews.

Secretary, Edward B. Chamberlain, 18 West Eighty-ninth Street, New York.

(Report by Edward B. Chamberlain)

At the meeting of the Sullivant Moss Society on December 28, Mr. Beals discussed and demonstrated the use of a large plate camera in photographing *in situ* small plants and mosses, either natural size or enlarged; Dr. Grout remarked upon a recent discovery of fossil mosses in the Iowa glacial deposits; Dr. Andrews outlined the need for a more natural grouping of the bryophytes, for greater monographic activity and for greater conservatism in specific and generic segregation. Attention was directed by Dr. Bailey to the rapid disappearance of the mosses of the Pacific Northwest through the combined operations of lumbering, fire and settlement; Dr. Conklin emphasized the value of the society collections in studying the distribution of American Hepaticæ; Mrs. Britton cleared up the confusion existing in certain West Indian species of *Fissidens;* and Dr. Holzinger gave an outline of the present status of the specific rank of *Desmatodon arenaceus.* Papers by Miss Lorenz and by Dr. Plitt dealt with the hepatic and the lichen flora of Mt. Desert Island, Maine. Mrs. Read told of the active study of mosses carried on for forty years by a section of the New England Women's Club, and Miss Cherrington made a plea for greater aid to the beginner in moss study.

The officers for 1923, given above, as well as the vice-president, Professor Charles C. Plitt, of the University of Maryland, were elected before the Boston meeting.

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INVESTIGATIONS ON THE BACTERIOLOGY OF EPIDEMIC INFLUENZA[1]

Epidemic influenza has been recognized for centuries, now under one designation, now under another. According to the exigencies of the period it has had a wide or a more restricted distribution: in early times human transport carried the pestilence slowly and over limited areas; in modern times, in a world knit closely together with frequent and rapid transport, it passes quickly from continent to continent.

The source of origin of the epidemics is still under discussion, and it remains for future study to determine whether the spread takes place from a single focus or from many foci of epidemicity. History traces the outbreaks of many epidemics to regions of Eastern Russia and Turkestan; but indications are not wanting that influenza smoldered in many endemic centers preceding the pandemic of 1918. Whichever of these divergent sources of origin proves to be the true one, certain undiscovered but essential conditions must be regarded as combining to convert endemic inactivity into epidemic spread.[2, 3]

THE EPIDEMIC OF 1918

The epidemic outburst of 1918, which was of unparalleled severity, coincided with the exigencies of the Great War so that the full weight and force of modern methods of clinical and bacteriological study could not quickly be brought to bear upon the disease. In many instances also investigators were further handicapped through failure to distinguish the primary infection from the frequent secondary pneumonias of common bacterial origin, or were prejudiced in their views by the general acceptance of Pfeiffer's bacillus as the bacterial incitant of influenza.

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[1] From the Laboratories of the Rockefeller Institute for Medical Research, New York, N. Y.

[2] Pearl, R., *U. S. P. H. S. Report* No. 548, 1919, xxxiv, 1744.

[3] Flexner, S., Science, l, 317.

Early in the course of the epidemic, discordant findings cast doubt on the part played by Pfeiffer's bacillus as the incitant of the disease. The doubt arose through the failure of certain competent investigators to find Pfeiffer's bacillus regularly in the blood or nasopharyngeal secretions of early cases, although, like other ordinary bacteria it was frequently found in the pneumonias that supervened on the primary infection. This organism was also reported as a secondary invader in other diseases, such as measles, whooping cough and tuberculosis, and occurred as often in normal throats as in the presence of respiratory infection. Antibodies against Pfeiffer's bacillus were not found, or could be demonstrated only with puzzling irregularity in the blood of recovered influenza patients, and serological variations among the pathogenic strains were so great that no single type could be identified as common to the majority of cases, although the rapid spread and common character of the epidemic would postulate a single incitant. Finally, vaccines containing Pfeiffer's bacillus and other ordinary bacteria cannot be said materially to have affected the incidence of influenza among those vaccinated. Apparently a certain protection against the secondary pneumonias could be effected by their use.[4]

Similarly, studies of other common bacteria (such as *Micrococcus catarrhalis*, or organisms of the streptococcus or pneumococcus groups) frequently found in the nasopharyngeal secretions or pathological exudates of influenza victims, failed to discover the primary infectious agent in the epidemic disease.

DEFINITION OF EPIDEMIC INFLUENZA

The other factor contributing to the confusion that existed during the early period of the epidemic was a frequent failure to recognize influenza as a specific primary disease, and to relegate the various bacterial pneumonias that developed in influenza-injured lungs to the rôle of secondary infections. Unless this distinction was clearly recognized, and the influenzal incitant sought only in the early hours of the disease, before it was masked and perhaps completely supplanted by associated organisms, little hope could be entertained of its recovery.

It is therefore important to define epidemic influenza in its early stages, before secondary infections obscure its specific characters. Our investigations were based on the uncomplicated disease within 36 hours after onset. Uncomplicated epidemic influenza is usually a mild affection. On the fringes of an epidemic it is not always easy to make an assured diagnosis from other indefinite ailments of the upper respiratory tract. In the midst of an epidemic, however, when many similar cases may be seen, its manifestations are more obvious and uniform. The onset is usually sudden with a chill, or chilly sensations, and fever. Headache, frontal or general, develops, with pains in the back, joints and extremities. In the severer cases the prostration that accompanies these symptoms forces the patient to bed. The eyes become inflamed and sensitive to light. The face is suffused; the throat edematous and raw, a thin irritating secretion flows from the nose, and the progress of the infection is denoted by hoarseness and a dry and distressing bronchial cough. Examination of the chest, however, reveals no certain signs of lung involvement. Other organs are not usually obviously affected. Pulse and respiration are only slightly accelerated. The temperature remains fairly constant, between 101.5 to 103° F. for two to four days and then, after a profuse perspiration, it falls rapidly to normal with the onset of convalescence.

A peculiar feature of the disease is an early drop in the circulating white blood cells to less than 5,000 cells per cubic millimeter. This diminution may persist through the acute stages of influenza and into convalescence. The mononuclear cells are particularly affected, but convalescence may witness a compensatory rise above the normal.

The duration of uncomplicated influenza is usually one to three days; in the severer cases four to six days. When symptoms persist beyond this period a secondary pneumonia or some other sequel is to be suspected.

Variants of the typical disease have been observed, with signs and symptoms referable to the gastro-intestinal tract, the nervous system and the heart. Mild and abortive cases also occur—cases that may be missed but that probably are capable of spreading the infection. These patients may experience the typical syndrome and show the characteristic changes in the blood picture, but are not so severely stricken as to be driven from their daily tasks. The presence of the influenzal injury is indicated, nevertheless, in an incidence of complications out of proportion to the apparent innocence of the primary ailment.

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[4] Park, W. H., *Jour. Immun.*, 1921, vi, 103; McCoy, G. W., *Jour. Amer. Med. Assn.*, 1919, lxxiii, 401.

The striking features of an epidemic, the features that give influenza its evil reputation, are the rapid spread, coupled with a high incidence of infection; so that more than half a population may be attacked in the first wave; the frequent occurrence of severe and fatal secondary pulmonary infections to which influenza makes its victims liable; and the recurrence of successive waves of diminishing extent and severity until, in the course of three or four years, the epidemic dies out.

EXPERIMENTAL INOCULATIONS

In September, 1918, when it was decided to undertake an etiological investigation of epidemic influenza in the laboratories of the Rockefeller Institute it was thought fruitless to attack the problem by the common cultural methods of bacteriology. Animal transmission experiments were considered first with a view to initiating an experimental infection of an influenzal character. Among the characteristic signs of the human infection, the typical changes in the blood picture seemed to promise a measurable diagnostic criterion. It also appeared probable that some pathological basis might be found for the striking defect in resistance to secondary infections which so often opened the way to pneumonias of bacterial origin.

The first experiments were undertaken with the unfiltered nasopharyngeal secretions of patients with uncomplicated epidemic influenza, as diagnosed from the train of symptoms and signs narrated above. These nasopharyngeal secretions, obtained by a saline lavage of the nose and throat, of course contained an extensive bacterial flora. It was expected, however, that in favorable instances ordinary bacteria might be suppressed by animal passage and that the specific effects of an extraordinary microorganism might thereby be revealed.

In a short series of experiments, monkeys (*Macacus rhesus*) were found to be unsuitable, because of their scarcity and the frequent presence of pulmonary infections (especially tuberculosis) in the stock. These preliminary experiments served, however, to orient us in methods of inoculation. Injections of influenzal nasopharyngeal secretions into the nose and throat, the conjunctivæ, the circulation and under the skin produced no distinctive effects. On the other hand, when the injections were made intratracheally into the lungs, the animals showed a subsequent decrease in the white cells of the blood, a change affecting chiefly the mononuclear cells. But this suggestive sign could not be correlated with local lesions in the lungs because of the frequence of pathological conditions due to other causes. Our results were essentially different from those obtained by Bradford, Bashford and Wilson[5] who obtained broncho-pneumonia and nephritis under similar experimental conditions. Nor could we cultivate from the monkey's lungs or from the nasopharyngeal material the "globoid bodies" described by them or by Gibson, Bowman and Connor.[6] The rabbit was then chosen as the experimental animal.

Inoculations through the trachea into the lungs of normal adult rabbits of the nasopharyngeal washings of patients in the early hours of influenza were found to be followed by characteristic effects. On the first or second day after injection the rabbits appeared ill, with ruffled fur, conjunctivitis, and, usually, a degree or two of fever. The constant feature was a definite and often striking numerical depression of the circulating white blood corpuscles, affecting chiefly the mononuclear cells, which often fell below 2,000 and sometimes below 1,000 per cubic millimeter. In the natural course of events these signs endured for two or three days and the animal then returned to normal. If the rabbit was killed at the height of the attack—for in the absence of secondary infection by ordinary bacteria none died—an unusual pathological picture was discovered in the lungs. The respiratory organs alone were visibly affected. The lungs were distended by an exudation of fluid (edema) into the interalveolar walls and by a large emphysematous space due to their rupture. On surface view and on cut section they were mottled with numerous large and small hemorrhages in the substance of the lung. Macroscopically, besides the edema, ruptures and hemorrhages, a scanty cellular exudate of mononuclear and, to a less extent, of polynuclear cells was found. The bronchii and bronchioles also were often filled with serous fluid and showed necrosis and exfoliation of their epithelium. Thus, while the lung structure was severely injured and disorganized in certain areas, there was a complete absence of the fibrinous and cellular consolidation of the lungs which characterizes pneumonias of ordinary bacterial origin. In many instances no ordinary bacteria could be recovered from the lesions either in stained impression films or by erobic or anerobic methods of cultivation. We concluded that the clinical and pathological effects induced by the intratracheal injection of the influenzal washings were independent of the presence of commonly recognized microorganisms.

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[5] Bradford, J. R., Bashford, G. P., and Wilson, J. A., *Quart. Jour. Med.*, 1918, xii, 259.

[6] Gibson, H. G., Bowman, F. B., and Connor, J. I., *Brit. Med. Jour.*, March 22, 1919, 331.

By the intratracheal injection of a saline suspension of ground lung tissue from a previously affected rabbit, the typical syndrome just described could be induced successively in a series of animals. In one instance 15 successive passages were obtained before the experiment was discontinued. Because of the persistence of these characteristic effects, in spite of the repeated dilution of the original material between passages, we were led to believe that we were dealing with a self-perpetuating agent; a living virus or microorganism.

It was soon found that the elements of this virus were of such minute proportions that they readily passed through earthenware filters impervious to ordinary bacteria. In this way it could be separated from other microorganisms in the nasopharyngeal secretions or in affected rabbits' lungs. The filtered material produced the typical train of clinical and pathological effects in rabbits and so proved that ordinary bacteria were not involved in the process. The microorganism was a filter-passer.

Now although very few filter-passing microorganisms have been identified, the group, in general, has certain well-known characters which this virus was found to share. For example, although it was readily killed by heat at 56° C., it was resistant to drying or freezing, and could withstand the action of 50 per cent. glycerol for periods up to nine months. When animal tissues containing it were contaminated by molds or bacteria the virus still survived.

Another noteworthy effect of this active agent early claimed our attention. When unfiltered nasopharyngeal secretions from influenza patients were intratracheally injected in rabbits, other microbic residents of the upper respiratory tract were likewise deposited in the animal's lungs. Ordinarily such bacteria do not produce lesions under these conditions, but are overpowered by the active protective mechanisms of the body. But in the presence of the primary injury caused by the influenzal agent these bacteria were sometimes able to multiply and cause severe pneumonias. We have already referred to the frequency of such a train of events in human cases, and the similarity of these accidental infections in the experimental animals led to a series of experiments to put this significant sequence of events to further test.

Thus it was found that a decrease in pulmonary resistance to such common bacteria as the pneumococcus, streptococcus, and *Bacillus pfeifferi* was a characteristic result of infection with the filterable virus. In some experiments, after the lungs had been damaged by the influenzal agent, the other organisms were injected into the trachea, since this is the route they are supposed to follow in man. In other experiments, as a severer test, small doses were injected into the circulating blood. Uniformly the common bacteria invaded the injured lungs and there induced a typical pneumonia. To the normal lungs of control animals the same doses of these microorganisms were harmless.

One more effect of the influenzal agent may be mentioned here before passing on to its identification. Rabbits allowed to recover from a primary infection with the virus were found to be immune to a subsequent inoculation.

In all, thirteen specimens of the active agent were recovered from the nasopharyngeal secretions of influenza patients in the first 36 hours of the disease. Five strains were obtained in 1918-1919, two during the recurrence of 1920 and six in 1922. During the same periods, three similar transmission experiments failed. On the other hand the active agent was not obtained from 12 influenza patients, the onset of whose illness had occurred more than 36 hours previously, nor from 17 persons free from influenza during the epidemic and inter-epidemic periods.

ARTIFICIAL CULTIVATION

In the beginning of this investigation, while the first animal transmission experiments were in progress, attempts were made to isolate the active agent in artificial cultures. For this purpose ordinary methods of cultivation were discarded in favor of the particular methods which Dr. Noguchi had developed in the course of his successful cultivation experiments with various highly parasitic treponemata, and with the filterable "globoid bodies" of poliomyelitis. These methods, in turn, were based on the earlier experiments of Dr. Theobald Smith. The Smith-Noguchi culture medium consists of sterile ascitic fluid or diluted serum, to which is added a small fragment of fresh, sterile, tissue —usually rabbit kidney. The peculiar attributes of the tissue fragment are not completely understood, but it seems to combine special nutritive or growth-promoting properties with a reducing activity which establishes anerobic conditions in the depth of the tube. The choice of this medium for the cultivation of the active agent of the transmission experiments proved to be a fortunate one.

In November, 1918, certain extremely minute but characteristic bodies were observed in strictly anerobic cultures of the filtered nasopharyngeal secretions of an influenza patient in the early hours of the disease. They approached the globoid bodies of poliomyelitis in size, but were somewhat longer in one axis than in the other. They stained with difficulty with the usual basic dyes and decolorized by Gram's method. That was about all that the sparse growths of the initial cultures revealed. Soon, however, other cultures were obtained, both from the filtered nasopharyngeal secretions of other influenza patients and from the whole or filtered lung tissue suspensions of rabbits which had been typically affected by these secretions, as has been described. As these minute microorganisms were carried through successive generations of culture, they became better adapted to artificial cultivation and multiplied more luxuriantly, so that the cultures could be used in animal experiments with unequivocal results. These experiments proved beyond question the *identity of the active agent obtained from influenza cases and the bodies obtained in culture.* Both were derived from the same sources. Both were filterable. Both produced identical clinical and pathological effects in rabbits, and from the pulmonary lesions produced by either, further animal passages, or cultures, could be obtained. Both, protected by bits of affected lung tissues, withstood 50 per cent. glycerol for periods of months. Both had that curious property of damaging the lung in such a way as to lower its resistance to secondary invasion with ordinary bacteria. It was from this character that the microorganism, objectively, received its name. We called it *Bacterium pneumosintes*—a bacterium that injures the lung. Finally, conclusive evidence of the identity of the virus and *Bacterium pneumosintes* was furnished by a series of experiments which showed that a previous infection with either one of these pathogenic agents rendered an animal immune to attack by the other.

IMMUNITY

In many infectious diseases, the immunity conferred by an attack is associated with the appearance in the blood of specific principles, or antibodies, which can be demonstrated by serological tests. Our efforts were therefore directed toward the observation of antibodies in the blood of experimentally infected rabbits, and of influenza patients, from which the strains of *Bacterium pneumosintes* ultimately had been derived. But it was found that cultures of *Bacterium pneumosintes* in the Smith-Noguchi medium were unsuitable for serological experiments. The sparse growth of the earlier generations was mixed with protein precipitate that interfered with agglutination and precipitation reactions and had antigenic properties that precluded its use. It was therefore necessary to devise special methods of cultivation, and before these methods were available the first opportunity was lost to test for antibodies in the blood of influenza patients and of affected rabbits.

We found later that if the Smith-Noguchi medium was enclosed in a collodion sac, surrounded by distilled water or physiological salt solution, anerobic conditions were shortly established throughout the system and the nutritive and growth-promoting substance of the medium diffused through the membrane in sufficient quantities to support a luxuriant growth in the surrounding liquid. The protein-precipitate that collected around the tissue fragment was retained within the sac.

When it was possible to cultivate *Bacterium pneumosintes* by this method in quantities sufficient for use, rabbits were repeatedly injected intravenously with small doses of live cultures, or of heat-killed organisms. After a suitable interval, their blood serum was found to possess specific antibodies against *Bacterium pneumosintes* which could be demonstrated by agglutination, precipitation, complement fixation and phagocytic tests. A significant feature of the immunological experiments and also of these serological tests was the fact that all the strains tested had similar antigenic properties and reacted identically with the specific antibodies produced by any one of them. This is what would be expected if they were all derived from a common source.

The development of immunity in experimental animals as a result of previous infection, and the appearance of serum antibodies after intravenous inoculation of living or killed cultures led us to infer that the mechanism of protection against *Bacterium pneumosintes* does not differ from that which comes into play in the case of infections with erobic pathogenic bacteria. Two important deductions, both susceptible of experimental proof, may be drawn from this conclusion.

One has already been mentioned—that the immunity conferred by an attack might be associated with the appearance of specific protective principles in the blood. The other is that these specific antibodies might be developed as a result of prophylactic subcutaneous injections of heat-killed organisms.

But in the absence of recent cases of influenza, or of fresh, pathogenic strains of *Bacterium pneumosintes*—(for the strains obtained in 1918-1919 and 1920 had become saprophytic from long cultivation) we were for some time unable to test these hypotheses. The opportunity was finally afforded by a recurrence of epidemic influenza in New York City in January and February, 1922.

With material obtained from a number of early cases of influenza in this outbreak we repeated all of the essential steps of the former investigation, so that this series of experiments served to check and confirm the results of the earlier work. In brief, from the nasopharyngeal washings of eight patients in the early hours of uncomplicated influenza, the pathogenic agent was transmitted to animals in six instances. One of the two failures may possibly be attributed to the fact that the nasopharyngeal secretions stood for 24 hours at room temperature before injection. From these animals or their successors, three new strains of *Bacterium pneumosintes* were isolated, and a fourth strain was recovered by direct cultivation from a ninth patient whose filtered secretions were not injected into rabbits.

Since the clinical and pathological effects produced in rabbits by the new strains of the active agent appeared to us to be identical with those observed during the former epidemic waves, it is not necessary to describe them again in detail. The new strains of *Bacterium pneumosintes,* when isolated in artificial cultures, also had properties identical with those of the old strains obtained in 1918-1919 and 1920.

For example, they had the same morphology and cultural characters. They were filterable. They resisted the action of 50 per cent. glycerol. They were typically pathogenic for rabbits and reduced the resistance of the pulmonary tissues to secondary invasion with common bacteria. The new strains were specifically agglutinated by immune serum made with the old strains, and *vice versa.* Rabbits immunized by intratracheal injection of the old strains were subsequently resistant to the new.

In the earlier transmission experiments *Bacterium pneumosintes* had not been identified with certainty in microscopic sections of affected rabbits' lungs, but during these recent studies, by special methods of staining, we demonstrated the presence of minute bodies, morphologically identical with *Bacterium pneumosintes,* in the pulmonary lesions of six rabbits injected with the active agent from 1922 cases of influenza. From three of these animals pure cultures of the organism were subsequently obtained.

With the 1922 strains of *Bacterium pneumosintes* we were now able to carry out the tests for specific antibodies in the blood of recovered influenza patients, and also the study of prophylactic vaccination which had long been postponed. In the first experiments specimens of serum from 19 persons who had recovered from influenza from 10 days to five months previously and from 22 other persons who gave no history of influenza since 1920 were studied in agglutination tests. The method used was one recently developed in the laboratory of the Rockefeller Institute, by Dr. Northrop and Dr. De Kruif[7] that increases the sensitiveness of the reaction without impairing its specificity. In the control tests no agglutinins or precipitins were found in the serum of 22 persons who had never had influenza or had not been recently attacked. We concluded that the blood of normal persons does not contain demonstrable antibodies against *Bacterium pneumosintes*. On the other hand, the serum specimens from 17 of 19 persons who had influenza during the recurrence of 1922 specifically agglutinated both old (1919) and new (1922) strains of *Bacterium pneumosintes*, and in 12 of 15 sera tested precipitins were also discovered.

One of the persons chosen as a control subsequently had clinical influenza. It was interesting to find that his blood serum, previously negative, contained agglutinins for *Bacterium pneumosintes* when tested on the tenth and eighty-ninth days after recovery. In other instances demonstrable agglutinins persisted in the blood for at least five months following an attack of influenza.

The second series of experiments that were made possible by the acquisition of new and pathogenic strains of *Bacterium pneumosintes* dealt with the immunizing effects in rabbits of subcutaneous injections of appropriate doses of the heat-killed organisms. When a number of rabbits had been prepared by three injections of the killed bacteria the protective effects of the vaccination were demonstrated in two ways. By serological examination it was found that 11 among 15 vaccinated animals had developed specific agglutinins against *Bacterium pneumosintes*. Their resistance was then tested to doses of the living organisms which were pathogenic for normal, unvaccinated animals. In all but two instances the protection was complete. Not only did the vaccinated rabbits fail to show the characteristic signs of infection with *Bacterium pneumosintes* but, with the two exceptions noted above, they were normally resistant to secondary infection with a pneumococcus, a streptococcus, or *Bacillus pfeifferi*. Incidentally, it was observed that the doses of vaccine were well borne and did not even temporarily reduce the rabbits' resistance to other infections. These experiments therefore pointed the way to a similar series of observations in man.

At the invitation of Lieutenant Colonel Charles F. Craig, a number of officers and enlisted men at the Army Medical School in Washington, D. C., volunteered to submit to vaccination with *Bacterium pneumosintes*. They were accordingly given three subcutaneous injections of killed culture in a manner similar to that employed with antityphoid vaccine. The doses chosen did not cause any severe local or general reactions, the subjective effects being somewhat milder than those experienced after antityphoid vaccination. But on the tenth or eleventh day after the final injection the blood serum of seven among nine men examined contained specific agglutinins for *Bacterium pneumosintes*, thus indicating the formation of protective antibodies as a result of the injection of vaccine.

On the basis of these observations the vaccine is being offered to much larger groups of men in the United States Army. It is not possible, of course, to determine the protective effects of these injections directly. In the event of a recurrence of epidemic influenza in the near future, however, the efficacy of vaccination with *Bacterium pneumosintes* as a preventive measure may be put to test. Meanwhile methods are at hand for the production of large amounts of vaccine if its widespread use should be indicated.

Before summarizing briefly the results of these experimental studies of the nasopharyngeal secretions of influenza patients mention may be made of the fact that *Bacterium pneumosintes* is not the only anerobic, filter-passing, Gram-negative microorganism to be found in the human respiratory tract. From the nasopharyngeal secretions of one influenza patient, and of a considerable number of other persons, normal or suffering from various mild respiratory infections, other filterable organisms, not *Bacterium pneumosintes* and not pathogenic for rabbits, have recently been cultivated. What the importance of these microorganisms may be, or whether they have any pathogenic significance, remains to be determined. They indicate, however, that the cultural methods recently employed in these studies may lead to the isolation of a group or groups of hitherto undescribed bacterial inhabitants of the upper respiratory tract and so they point to interesting opportunities in this field of bacteriology.

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[7] Northrop, J. H., and De Kruif, P. H., *Jour. Gen. Physiol.*, 1922, iv, 639, 655.

CONCLUSIONS

In conclusion, we have isolated from the nasopharyngeal secretions of influenza patients in the early hours of the epidemic disease a hitherto undiscovered organism, *Bacterium pneumosintes,* filterable, anerobic, resistant and pathogenic for rabbits, in which it induces a typical infection comparable with epidemic influenza in man. The significant features of this experimental infection are the incidence of a leucocytic depression chiefly affecting the mononuclear cells, and the production of a characteristic lesion in the lungs associated with a defect in their resistance to secondary invasion with common pathogenic bacteria.

All our strains of *Bacterium pneumosintes* have similar antigenic properties, indicating a common source. Animals subjected to a primary infection, or injected with living or killed organisms are immune to subsequent injection. The killed bacteria induce specific antibody formation even when injected subcutaneously in doses well tolerated by man. The blood serum of recovered influenza patients contains agglutinins for *Bacterium pneumosintes,* whereas that of normal persons does not.

On the basis of these experimental observations, reported in detail in *The Journal of Experimental Medicine,*[8] and especially in view of the source of the cultures, their clinical and pathological effects in rabbits, their antigenic identity, and the presence of specific agglutinins in the blood serum of recently recovered influenza patients, it might seem justifiable to claim *Bacterium pneumosintes* to be the bacterial incitant of epidemic influenza. At present, as already stated in an earlier report, such a course does not seem desirable. Apparently we are at the threshold of knowledge of a group or class of minute microorganisms which the anerobic Smith-Noguchi technique and more recently developed methods of cultivation have thrown open to exploitation. It has seemed wiser, therefore, merely to report the experimental facts, and to defer decision of the precise relation which *Bacterium pneumosintes* bears to epidemic influenza until further experience is obtained.

PETER K. OLITSKY
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GARDEN FOR THE PROPAGATION OF TROPICAL AND SUBTROPICAL PLANTS

UNDER a revocable license, which it is believed insures a sufficiently long tenure to secure useful results, Secretary Weeks has just turned over to Secretary Wallace the Chapman Field air station of 850 acres, located on Biscayne Bay, 12 miles south of Miami, Florida. This tract has a coast line of 1⅖ miles and is composed of about 195 acres of pine land and rock reef and 655 acres of low land and mangroves, more or less subject to overflow during the high waters. Of this latter, 80 acres have been filled above high water level and will be made available for use as soon as the salt has been washed out of it.

The striking feature of this tract of land is that it is located in one of the warmest spots on the whole peninsula of Florida, which means that it is less liable to cool winter temperatures than almost any other spot in continental United States. Vegetation which is strictly tropical, such as that of the mango, coconut palm, and West Indian avocado can be grown here in perfect safety. It is not commonly understood that in such a station can be propagated to advantage a wide range of those valuable food and otherwise useful plants upon which the development of the horticulture of the tropics is dependent.

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[8] Olitsky, P. K., and Gates, F. L., *Jour. Exper. Med.,* 1921, xxxiii, 125, 361, 373 and 713; *ibid.,* 1921, xxxiv, 1; *ibid.,* 1922, xxxv, 1, 553 and 813; *ibid.,* 1922, xxxvi, 685. Papers XI and XII in press.

The insect pests and fungus diseases which make plant propagating difficult and the distribution of small nursery plants so dangerous in the tropics can be kept under control on this coast of Florida, and this control represents an advantage of no mean importance in the dissemination of tropical plants.

Not only this. The growth of Florida has thrown into a region in which the white man can work out of doors hundreds of thousands of intelligent horticulturists who are keenly interested in the development of those fruits, vegetables, forage crops and grains which can be grown somewhere on the 54,000 square miles of Florida territory, a region which in area is only one fifth less than the whole of New England with its six and a half millions and more than half as large as the whole West Indies with their six millions of people.

The Department of Agriculture has maintained in Miami since 1898 a Plant Introduction Garden and research laboratory on Brickell Avenue, on seven acres of land the use of which was given the department by the late Henry M. Flagler and Mrs. Mary Brickell, and since 1914 a twenty-five acre garden at Buena Vista, on land given to it by Mr. Charles Deering, of Chicago.

With the great influx of settlers into south Florida, the growing interest of Americans in the tropics, and the increase in utilization of tropical plants by Americans in Panama, Hawaii, and Porto Rico, has come the evidence that much more comprehensive facilities must be arranged for to take care of the coming demand for useful tropical plants than has hitherto been realized.

The stringency of the regulations covering the importation of living plants from tropical countries has tended largely to increase the demand for government aid in their introduction and the first step in meeting this demand is the acquiring of a suitable site of adequate size for the operation of a plant introduction garden.

Through the action of Secretary Weeks, this first step in the origination of this new garden has been made possible.

The range of plants which will be grown and sent out from the new Chapman Field Garden will include many which are adapted to regions visited by severe frosts, for it has been found that under lath sheds a very wide range of young plants can be grown economically.

While the distribution of new experimental plants will always be a prominent feature of the new garden, a test orchard and arboretum will be gradually built up, in which will be preserved collections of the valuable and beautiful trees and shrubs of foreign countries which are adapted to the soil and climate of Chapman Field.

Inasmuch as it will require several years to build up such a garden, and, inasmuch as there are growing at the Brickell Avenue and Buena Vista gardens many rare and valuable specimen plants, these older gardens will be maintained for the present and probably for some time to come.

In how far this garden can fulfil the functions of an arboretum such as the Arnold Arboretum the circumstances of funds and soil conditions will determine. That it can be developed into a center of tropical agricultural research seems certain. Its position on the waters of the Caribbean, within thirty-six hours of the great centers of American civilization, cannot fail to make it in time the most available spot for American students to visit, who want to get an idea of the great problems of the tropics and live in a perfectly healthy climate in an intellectually stimulating community.

To the state institutions of Florida especially the collections of tropical plants must appeal particularly, for from the growing body of students of agriculture and horticulture of that state should come the men and women who will develop the new tropical vegetables, fruits, forage crops and ornamental plants which are destined to compose not only the agriculture of Florida but the agriculture of many strictly tropical regions as well. In time it should become a center where the strictly tropical plants will be bred with the hardier forms of the regions further north and result in combinations of characters hitherto unknown. Plant breeding has so far scarcely touched the tropics, and the opportunities presented by a garden at Chapman Field for the production of new and valuable forms are believed to be very unusual.

There is a special romance connected with this spot on the coast of Florida which ought to appeal to all agriculturists. Chapman Field, which is named in honor of Manuel Chapman, the first American aviator to fall in the great war, joins on the east the Perrine grant which was the first grant of any kind whatever made by the Congress of the United States in aid of agriculture. It was made July 7, 1838, to Dr. Henry Perrine who was killed by the Indians while he was making efforts to establish on his grant tropical trees and plants, particularly the sisal fiber plant from Yucatan, for which plant introduction purpose he had been granted a township of land in what was then the wilderness of south Florida.

As the work develops, the Chapman Field Garden will place its facilities at the disposal of the investigators in other offices of the Bureau of Plant Industry. Under proper departmental procedure, it will also cooperate with other research institutions throughout the country. Studies in the tropics or subtropics often shed a new light upon problems of northern agriculture and have a broadening influence of great value upon the mind of any investigator.

Much of the equipment remaining at Chapman Field, such as its water system, buildings, etc., can be utilized.

The management of this new garden will be in the office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry.

David Fairchild
Agricultural Explorer in Charge

Office of Foreign Seed and
Plant Introduction,
January 12, 1923

SCIENTIFIC EVENTS

THE CARNEGIE CORPORATION

According to the report of the president of the Carnegie Corporation made public on February 5, the major interests at present receiving their support wholly or largely from this corporation are the Institute of Economics in Washington, an agency for analyzing and publishing economic facts in popular form; the Food Research Institute at Leland Stanford University, a scientific extension of studies in the production and distribution of foods begun by Mr. Hoover during the war; the National Research Council in Washington, an organization that aims to focus and promote all sorts of scientific research in America; the Potter Metabolic Laboratory at Santa Barbara, California, where insulin, the recently discovered specific for diabetes, is being manufactured and perfected; the American School of Classical Studies at Athens, for which the corporation is paying the cost of a building to house a library recently acquired by the school; and comprehensive investigations into the fundamentals of unemployment and into the means of improvement of the law.

A total of $5,254,000 has been paid to beneficiaries during the year ended September 30, 1922, of which $2,578,000 went to colleges and universities. Of nearly $58,000,000 expended during the eleven years of the corporation's existence, $23,415,000 has been given to Carnegie institutions: the institution at Pittsburgh, the foundation in New York and the institution and the peace endowment in Washington. In addition to $30,000,000 granted by Mr. Carnegie personally for public library buildings, $12,292,000 has been devoted by the corporation to the same purpose. Schools and colleges have received $9,276,000; medical and health education, $3,266,000; and scientific research, $1,511,000, chiefly within the past four years.

The report explains the policy of the corporation in discontinuing its gifts of libraries, and in a discussion of the "science of giving," notes the difficulties of making wise public benefactions.

The assets of the corporation amount to $130,000,000, which will be increased by about $10,000,000 on the final settlement of Mr. Carnegie's estate. The board of trustees, which includes as *ex officio* members the heads of the six important Carnegie organizations, is to be enlarged from ten to fifteen members. As has already been noted, Dr. Frederick P. Keppel, formerly dean of Columbia College and this year in charge of work for the Russell Sage Foundation, has been elected president of the corporation.

THE PROPOSED REORGANIZATION OF FEDERAL HEALTH ACTIVITIES

We learn from a report in the *Journal* of the American Medical Association that, on

January 17, a conference was held in the office of Brigadier General C. E. Sawyer, physician to President Harding and chief coordinator of the federal Board of Hospitalization, to consider plans for the coordination of the health activities of the federal government. In addition to General Sawyer and the surgeon-generals of the army, the navy and the public health service, there were present Dr. A. W. Belting, president Eastern Homeopathic Medical Association, Trenton, N. J.; Lieutenant Commander J. T. Boone, Medical Corps, U. S. Navy; Dr. Claude A. Burrett, Rochester, N. Y.; Dr. Gilbert Fitzpatrick, chairman, executive committee, American Institute of Homeopathy, Chicago; Dr. C. W. Garrison, executive secretary and state health officer, State Board of Health, Little Rock, Ark.; Dr. James A. Hayne, secretary and state health officer, State Board of Health, Columbia, S. C.; Dr. A. T. McCormack, president, Conference of State and Provincial Health Authorities of North America, and secretary, State Board of Health, Louisville, Ky.; Dr. R. M. Olin, state health commissioner, Lansing, Mich.; Colonel W. O. Owen, Washington, D. C.; Dr. W. A. Pearson, dean, the Hahnemann Medical College and Hospital, Philadelphia; Dr. Ennion G. Williams, state health commissioner, Richmond, Va., and Dr. William C. Woodward, executive secretary, bureau of legal medicine and legislation, American Medical Association.

According to the plan submitted by General Sawyer, the proposed department will be known as the Department of Education, Health and Welfare, with a secretary who is to be a cabinet officer at its head, and an assistant secretary. The plan calls for the creation of a bureau of education, a bureau of health, a bureau of social service, and the Veterans' Bureau, each with a director-general at its head. It is to be expected, of course, that the secretary, and possibly the officer next in rank, the assistant secretary, will, because of their rank and their relation to the determination of the policies of the government, change with each administration. The several director-generals, however, are to be the technical heads of the bureaus, and as more or less permanent officers to preserve continuity of policy and administration. The plan calls for no enlargement or reduction in the activities of the several branches of the federal government now engaged in work in the lines of activities to be incorporated in the new department. It is proposed that the various agencies of the federal government (except those within the army and navy) relating to health, education, social service and the rehabilitation of veterans be transferred to the new executive department, each to carry with it its present powers, appropriations and personnel, intact. It was suggested that the prospect was never better than now for the establishment of medicine as a fixed unit, associated with other departments of the government, providing in a most satisfactory and effective way for carrying out the highest ideals of modern medicine. An executive committee to carry forward the work of the conference was appointed by the chairman, consisting of Drs. Fitzpatrick, Olin and Woodward.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology held its tenth annual meeting in Toronto, Canada, December 27, 28 and 29, under the auspices of the University of Toronto. This meeting was one of the most successful ever held, due largely to the carefully laid plans of the local committee. The local committee was composed of Professors Andrew Hunter, *chairman;* V. E. Henderson, *secretary;* V. J. Harding and H. B. Speakman. The total registered attendance was 244, made up of 134 members of the federation and 110 non-members.

In the absence in China of Dr. Donald D. Van Slyke, president of the American Society of Biological Chemists, the vice-president, Professor Philip A. Shaffer, Washington University Medical School, served as chairman of the federation. The biochemical secretary, Professor Victor C. Myers, New York Post-Graduate Medical School, was the executive secretary.

A joint session dealing with topics of general interest was held on Wednesday morning, December 27. The dinner on the same evening was in honor of the birth of Louis Pasteur. Following the address of welcome by Sir Robert Falconer, president of the University of Toronto, Professor Graham Lusk spoke on

Pasteur, the man, Professor F. G. Novy considered Pasteur's contributions to bacteriology, while Professor A. P. Mathews gave a brief account of Pasteur's contributions to chemistry. Thursday afternoon was given over to a long series of interesting and important demonstrations, two of which were given by Professor R. Barany, of the University of Upsala. The papers on the joint program of the final afternoon all dealt with the pancreatic hormone, insulin, chiefly with its nature and action. This session attracted a great deal of interest and was a fitting climax to the meetings, especially since this work was first inaugurated at the University of Toronto.

The individual meetings of the four constituent societies were held on Wednesday afternoon and Thursday and Friday mornings. A meeting of the Annual Conference of Biological Chemists was held on Thursday evening.

The officers of the four societies elected for 1923 are as follows:

American Physiological Society: *President*, A. J. Carlson; *secretary*, C. W. Greene; *treasurer*, Joseph Erlanger; *new members of the council*, Arno B. Luckhardt, John R. Murlin.

American Society of Biological Chemists, Inc.: *President*, Philip A. Shaffer; *vice-president*, Henry C. Sherman; *secretary*, Victor C. Myers; *treasurer*, Walter R. Bloor; *additional members of the council*, Andrew Hunter, Harold C. Bradley, Albert P. Mathews; *nominating committee*, C. L. Alsberg, S. R. Benedict, Otto Folin, Walter Jones, E. C. Kendall, P. A. Levene, J. R. Murlin, F. P. Underhill, D. W. Wilson.

American Society for Pharmacology and Experimental Therapeutics: *President*, C. W. Edmunds; *secretary*, E. D. Brown; *treasurer*, Hugh McGuigan; *additional members of the council*, P. J. Hanzlik, H. G. Barbour; *membership committee*, T. Sollmann, Carl Voegtlin, R. A. Hatcher.

American Society for Experimental Pathology: *President*, Eugene L. Opie; *vice-president*, A. S. Warthin; *secretary-treasurer*, Wade H. Brown; *councilors*, G. H. Whipple, H. Gideon Wells.

The executive committee of the federation is composed of the presidents and secretaries of the four societies. For 1923 the chairmanship and executive-secretaryship falls to the Pharmacological Society, Professor C. W. Edmunds, University of Michigan, being chairman, and Professor E. D. Brown, University of Minnesota, executive secretary.

The executive committee voted to hold the 1923 meeting in St. Louis.

THE JAPANESE MEDICAL COMMISSION

A RECENT cable dispatch from Tokyo announces the appointment of Baron Yoshihiro Takagi, chief surgeon and professor of surgery in the Tokyo Charity Hospital and Medical College, as a member of a commission of six Japanese doctors who will arrive in the United States early in March as guests of the Rockefeller Foundation for the purpose of studying American and Canadian medical institutions and methods.

The commission was appointed by the Japanese minister of education, Dr. Eikichi Kamada, to whom the foundation's invitation was extended by President Vincent through Baron Shidehara, the Japanese ambassador at Washington. Nominations for membership in the commission were made by the Japanese Committee for Graduate Medical Education in the United States, headed by Baron Sakatani, under whose auspices a number of Japanese physicians have pursued post-graduate studies in the United States. The six members of the commission are:

Dr. Kinnosuke Miura, professor of medicine, Tokyo Imperial University, the leading internist and diagnostician in Japan, and a specialist in neurology; he is physician in ordinary to the emperor, and accompanied the Japanese delegation to Versailles.

Dr. Sahachiro Hata, professor of medicine, Keio University, and director of the Kitasato Institute; collaborator with Ehrlich in the discovery of salvarsan, and a distinguished biological chemist.

Dr. Keinosuke Miyairi, dean of the medical college, Imperial University of Kyushu, a parasitologist.

Dr. Mataro Nagayo, professor of pathology and pathological anatomy, Tokyo Imperial University.

Dr. Akira Fujinami, professor of pathology and pathological anatomy, Kyoto Imperial University.

Baron Yoshihiro Takagi, chief surgeon and professor of surgery in the Tokyo Charity Hospital and Medical College.

The commission as a whole, or individual members, will visit the leading hospital and research centers in the United States and Canada, including New York, Philadelphia, Baltimore, Boston, St. Louis, Cleveland, Chicago, Rochester, Minn., Montreal and Toronto.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRESIDENTS and recorders of the sections of the British Association for the Advancement of Science have been appointed for the Liverpool meeting to be held in September under the presidency of Sir Ernest Rutherford as follows:

Section A (Mathematical and Physical Science): Professor J. C. McLennan; Professor A. O. Rankine, Imperial College of Science and Technology, S.W.7.

Section B (Chemistry): Professor F. G. Donnan; Professor C. H. Desch, The University, Sheffield.

Section C (Geology): Dr. Gertrude Elles; Dr. A. R. Dwerryhouse, Toots, Darell Road, Caversham, Reading.

Section D (Zoology): Professor J. H. Ashworth; Professor R. D. Laurie, University College, Aberystwyth.

Section E (Geography): Dr. Vaughan Cornish; Dr. R. N. Rudmose Brown, The University, Sheffield.

Section F (Economics): Sir W. H. Beveridge; Professor H. M. Hallsworth, Armstrong College, Newcastle-on-Tyne.

Section G (Engineering): Sir H. Fowler; Professor G. W. O. Howe, The University, Glasgow.

Section H (Anthropology): Mr. P. E. Newberry; Mr. E. N. Fallaize, Vinchelez, Chase Court Gardens, Enfield, Middlesex.

Section I (Physiology): Professor G. H. F. Nuttall; Professor C. Lovatt Evans, Physiological Laboratory, St. Bartholomew's Medical College, E.C.1.

Section J (Psychology): Mr. C. Burt; recorder not yet appointed.

Section K (Botany): Mr. A. G. Tansley; Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge.

Section L (Educational Science): Professor T. P. Nunn; Mr. D. Berridge, The College, Malvern.

Section M (Agriculture): Dr. C. Crowther; Mr. C. G. T. Morison, School of Rural Economy, Oxford.

SPENCER FULLERTON BAIRD

THE one hundredth anniversary of the birth of Baird was commemorated at a meeting held in the auditorium of the United States National Museum on February 3. The Honorable Frank L. Greene, member of the House of Representatives and member of the board of regents of the Smithsonian Institution, presided, and addresses were given as follows:

"Baird the Man," Dr. William Healey Dall; "Baird and the Smithsonian Institution and its branches," Dr. Charles Greeley Abbot; "Baird at Woods Hole," Professor Edwin Linton; "Baird and the fisheries," Professor David Starr Jordan; "Baird the naturalist," Dr. Clinton Hart Merriam.

The meeting had been arranged by the National Baird Memorial Committee, of which the officers were as follows: *Honorary president,* Dr. William H. Dall; *president,* Dr. Charles D. Walcott; *vice-presidents,* Mr. George R. Agassiz, Dr. Alexander Graham Bell (deceased), Professor Frank W. Clarke, Professor Stephen A. Forbes, Professor David Starr Jordan, Professor Edwin Linton, Professor Edward S. Morse, Professor Henry Fairfield Osborn, Professor Addison E. Verrill and Dr. Robert S. Woodward; *secretary,* Dr. Paul Bartsch.

The membership of the committee included representatives of fifty-four scientific societies and other organizations. At the close of the meeting the report of the committee was presented by Dr. L. O. Howard. It included the following recommendations:

First: That the Congress be memorialized to establish in the city of Washington a museum of fisheries and oceanography, a laboratory and a public aquarium as a memorial to Spencer Fullerton Baird.

Second: That there be established a fund for the encouragement of research and exploration in the direction in which Spencer Fullerton Baird was a leader.

Third: That the name of Baird be given to the laboratory of the Bureau of Fisheries at Wood's Hole, Massachusetts.

SCIENTIFIC NOTES AND NEWS

SECRETARY HOOVER has appointed the board of visitors of the United States Bureau of Standards for a period of three years as follows: President F. W. McNair, of the Michigan College of Mines; Dr. Ambrose Swasey, of Cleveland, Ohio; Dr. John R. Freeman, of Providence, Rhode Island, a consulting engineer; Professor Wilder D. Bancroft, of Cornell University, and Dr. Samuel W. Stratton, formerly director of the bureau and now president of the Massachusetts Institute of Technology.

The portrait of Professor A. A. Michelson, for thirty years head of the department of physics at the University of Chicago, has been completed by Ralph Clarkson, of Chicago, and turned over to the University of Chicago. The portrait was provided by the gifts of Professor Michelson's colleagues, former students, and other friends. It will be hung, temporarily, in the Quadrangle Club.

In honor of the seventy-fifth birthday of Professor Flügge, who was for many years the director of the Hygienic Institute in Berlin, Professor Kayserling, of the Robert Koch Foundation for Combating Tuberculosis, has founded a Flügge fund for tuberculosis research.

The council of the Geological Society, London, has this year made the following awards: Wollaston Medal, Mr. W. Whitaker; Murchison Medal, Dr. J. Joly; Lyell Medal, Mr. G. F. Dollfus; Bigsby Medal, Mr. E. B. Bailey; Wollaston Fund, Mr. H. H. Read; Murchison Fund, Mr. T. H. Withers; Lyell Fund, Dr. W. T. Gordon and Dr. W. N. Benson.

We learn from *Nature* that the Buys Ballot Medal founded in 1888 in commemoration of the work of C. H. D. Buys Ballot, the famous meteorologist of the Netherlands, to be awarded by the Royal Academy of Science at Amsterdam first in 1893, and afterwards every tenth year, to the person who is judged to have made the most valuable contributions to the science of meteorology, is to be given this year to Sir Napier Shaw, professor of meteorology in the Royal College of Science, lately director of the Meteorological Office, for contributions to all branches of the science, and specially for his work as president of the International Meteorological Committee. The previous awards were: 1893, Dr. Julius Hann, of Vienna; 1903, Dr. R. Assmann and Dr. A. Berson, of Berlin, jointly; 1913, Dr. H. Hergesell, of Strasbourg.

Professor George E. Beggs, of the School of Engineering of Princeton University, has been presented with the Watson Medal of the American Concrete Institute for the year 1922. This medal is awarded for the most meritorious paper presented before the institute during the year. Mr. Beggs's paper, on "The mechanical solution of indeterminate structures," discusses the method of designing indeterminate structures in concrete and steel by solutions obtained from models made of cardboard and celluloid.

Dr. Warren P. Lombard, for twenty years professor of physiology at the University of Michigan, will retire in June. Dr. Lombard has been appointed professor emeritus and will retain a laboratory in the medical school. The following resolution was passed by the board of regents: *"Resolved,* That in accepting the resignation of Dr. Warren P. Lombard, the board desires to record its deep appreciation of his long and distinguished service to the university and to science. He has contributed much to the social and official life of the institution, always cheerfully and efficiently."

Mrs. Anna Botsford Comstock, until 1921 professor of entomology at Cornell University, has been nominated for trustee of the university. Mrs. Comstock was nominated in 1922, losing by a narrow margin, but polling a higher vote than any previous winner.

Dr. Borden S. Veeder, professor of clinical pediatrics at Washington University School of Medicine, has been named as a director of the new American Child Health Association.

Dr. Marston T. Bogert, professor of organic chemistry, at Columbia University, has been appointed referee in chemistry for the American Field Service Fellowships for French Universities.

Dr. Francis H. McCrudden, professor of therapeutics at Tufts Medical School, has been made chief of the medical service of the U. S. Public Health Service Hospital, Washington, D. C.

Professor Vladimir Karapetoff, of Cornell University, has been granted leave of absence for the second term of this year.

Dr. Pentti Eskola, who has been engaged in research work at the Geophysical Laboratory, Carnegie Institution of Washington, for the past eighteen months, has returned to Finland to undertake work for the Geological Survey of that country.

PROFESSOR JAMES GLOVER, of the department of mathematics of the University of Michigan, has accepted an invitation to give a lecture under the auspices of the DeLamar foundation on February 19 before the School of Hygiene and Public Health of the Johns Hopkins University. He will speak on "Life tables as applied to public health problems."

ON February 13, Dr. George T. Moore, director of the Missouri Botanic Garden, St. Louis, will speak before the Chamber of Commerce Forum on "The civic value of the botanic garden."

PROFESSOR JOSEPH JASTROW, of the University of Wisconsin, on the invitation of the department of psychology at Clark University, gave a public lecture on January 27, on "Spirit belief, occult and scientific."

DR. CHARLES WARDELL STILES, professor of zoology in the United States Public Health Service, has recently given three lectures before the Journal Club of the department of medical zoology, School of Hygiene and Public Health, Johns Hopkins University, as follows: January 12, "The public health aspects of trichinosis"; January 19, "The attitude of the Public Health Service toward clonorchiasis"; and January 26, "Surveys of intestinal protozoa."

PROFESSOR HELLPACH, instructor in psychology at the polytechnic in Karlsruhe, now minister of public instruction in Baden, delivered last month an address before the Heidelberg Society of Science and Medicine on the influence of heredity and environment on physiognomy or facial expression.

AT a joint meeting of the Washington Academy of Science with the Geological Society of Washington on January 24, M. E. De Margerie, director of the Geological Survey of Alsace-Lorraine, delivered an address on "The structure of the Alps."

THE annual council meeting of the British National Union of Scientific Workers was held at the Caxton Hall, Westminster, on January 13. Dr. A. A. Griffith, who presided, gave an address on "The support and utilization of science. Dame Helen Gwynne-Vaughan was elected president.

THE St. Louis Chapter of the American Library Association met at the library of the Washington University School of Medicine, on January 24, 1923. Dr. H. S. Gasser, professor of pharmacology, spoke on "William Beaumont," the pioneer American physiologist; Dr. Major G. Seelig, professor of clinical surgery, spoke on "Personal recollections of Professor Julius Pagel." The Beaumont collection of manuscripts and books and the Pagel collection on the history of medicine were on exhibition.

THE Royal Society of Medicine celebrated the Jenner centenary on January 26 when Sir William Hale-White gave an address on "Jenner and his work."

THE Oklahoma Academy of Science will hold its annual meeting at the University of Oklahoma on February 10. One of the main features of the meeting, in addition to the reading of scientific papers showing research work done in the state, is the celebration of the one hundredth anniversary of the birth of Gregor Mendel and Louis Pasteur. The celebration will be held at a noonday luncheon, at which members of the academy will discuss the contributions these men made to science.

PROFESSOR GEORGE LEFEVRE, chairman of the department of zoology in the University of Missouri, died at his home in Columbia, Mo., on January 24. He had been suffering from a cold, but was comfortable and in the best of spirits until January 18, when he left the laboratory complaining of renewed discomfort. His illness was pronounced influenza and later pneumonia. On January 21 his condition was serious and after a slight rally on the day following he sank rapidly until the end. The burial was in Columbia on January 26. A further notice regarding his life and personality will appear in a subsequent number of SCIENCE.

DR. JOHN BERRY HAYCRAFT, emeritus professor of physiology in the University of Wales, died at Royston on December 30, aged sixty-five years.

GIFTS of $1,000,000 each have been made by the Rockefeller Foundation and the Carnegie

Corporation to the New York Academy of Medicine. A part of the money is to be used in erection of a twelve-story building for the academy, which is planning an enlarged program for the medical profession and for the instruction of the public in preventive medicine.

DR. MAX NORDAU, the German philosopher, author of "Degeneration," died in Paris on January 23, in his seventy-fourth year.

THE Journal of the American Medical Association states that the University of Toronto is in urgent need of $60,000 to purchase "insulin" for treatment of the thousands of people suffering from diabetes who are daily applying for treatment. The chairman of the university committee on insulin, Colonel A. E. Gooderham, considers that the problem of funds for the purchase of insulin is one that should be settled by the provincial government. At present, only about twenty patients can be treated each day.

ANNOUNCEMENT was made at the meeting at Atlantic City of the American Roentgen Ray Society of an offer of a $1,000 award by the American Society for the best original research in the field of X-ray, radium or radio activity. The competition will close July 1, 1923, and the prize will be awarded by a committee consisting of Dr. George E. Pfahler, Philadelphia; Dr. Frederick Baetjer, of Baltimore, and Dr. George W. Holmes, of Boston.

THE *Gorny Journal*, relating to the mining industries of Russia, and first issued in 1825, has resumed publication. It was supplanted in 1917 by official sheets of the labor organizations, but in its January-February issue of Volume 98 (1922) it returns to its original form. The board in charge of its publication includes a majority of members who were at the head of mining affairs before the revolution, as well as a considerable number of professors of the Petrograd Institute of Mines.

THE preparation by the Paris Academy of Sciences under the direction of M. Lacroix, permanent secretary, of a bibliography of the periodicals to be found in the various libraries of Paris has been completed and is now in press. Fifty thousand francs are required to pay expenses. Of this sum, nine thousand francs have been received in gifts and the academy has added fifteen thousand francs taken from the Foundation Lontreuil.

A REGULAR meeting of the American Physical Society will be held in Fayerweather Hall, Columbia University, New York, on Saturday, February 24. If the length of the program requires it, there will also be sessions on Friday, February 23. Other meetings for the current season are as follows: April 20-21, Washington. Pacific Coast Section; place not yet determined. November 30, Chicago. Annual meeting.

UNIVERSITY AND EDUCATIONAL NOTES

PLEDGES amounting to approximately $1,000,000 have been given for the establishment of a non-sectarian school of religion for the University of Michigan.

Two science buildings are being completed at Pomona College, Claremont, California. The Mason Hall of Chemistry, made possible through the generosity of a trustee, will cost $275,000, including adequate provision for its endowment. The Crookshank Hall of Zoology is being erected at a cost of $100,000.

THE China Medical Board of the Rockefeller Foundation has made a conditional gift of $75,000 to the Peking Union Medical College for the erection of one of the two science halls which are provided for in the plans for a group of buildings to be erected on a 300-acre site. The gift is contingent on the raising of an equal amount for the erection of the other science hall. A campaign to raise the $1,000,000 necessary for the erection of the new buildings was recently launched by L. Leighton Stewart, president of the university.

DR. WILLIAM S. MCCANN, associate professor of medicine at Johns Hopkins University, has been appointed professor of medicine at the University of Rochester Medical School.

M. PAILLOT has been appointed to the newly established chair of experimental physics at the University of Lille.

DR. L. E. ROBERTS, physical chemist at the U. S. Bureau of Mines, has accepted the position of assistant professor of chemistry at the University of Arizona, to fill the position vacant by the death on November 21 of Professor B. Tatarian.

M. Lassour has been appointed professor of microbiology at the University of Nancy.

DISCUSSION AND CORRESPONDENCE

THE STARCH GRAIN

To the Editor of Science: The article by O. L. Sponsler on "The structure of the starch grain" in the November issue of the *American Journal of Botany* is of more than ordinary interest. If we understood the structure of the starch grain and could produce it artificially in the laboratory it would mark the beginning of our intimate knowledge of biological problems.

The starch grain is elusive and one may study hundreds of specimens and yet not have the typical specimen revealing its intimate structure. Some years ago I obtained a hint from Fischer's work on Inulin. Late on a summer's afternoon I went to the laboratory and treated all of the starches which I had with aniline dyes. The mixtures were allowed to spontaneously evaporate over night and I obtained specimens which showed without doubt the complex nature of the grains. This was particularly true of potato starch. As I had a quantity of the stained material, I supplied all who wished specimens and it was not until a year or more later when I attempted to repeat the experiments, that I could not confirm my original work. I then very carefully attacked the problem in much the same way as I had studied the continuity of protoplasm, but to no avail. I worked for several years trying to repeat these experiments but have never succeeded since.

Mr. Sponsler has studied the starch grain using X-rays in much the same way that Herzog and Jancke had done in the study of the cell wall. Mr. Sponsler's attack of this problem is of very great scientific interest and while his results seem to indicate that the starch grain does not have a crystalline structure, I doubt if the results are conclusive. As I have shown, there is a substance in the grain which is dextro-rotatory and it is not at all difficult to observe starch grains which show, as pointed out by Meyer and Schimper, a spherocrystal structure.

Henry Kraemer

Kraemer Laboratories,
Mt. Clemens, Michigan

WHAT IS A PLANT?

The writer has unsuccessfully sought for a definition of the term *plant* suitable to use when introducing the subject of botany to college classes. The definitions given in the dictionaries are all unsatisfactory. According to Webster's International Dictionary (1922), a plant is "any member of a group of living organisms exhibiting irritability in response to stimuli, though generally without voluntary motion or true sense perception." Funk and Wagnall's Standard Dictionary (1913) defines a plant as "an organized, non-sentient being endowed with vegetable as distinguished from animal life." Both definitions, but particularly the latter, recall Linnæus' distinction, long discarded, of plants as structures that grow and live, while animals grow, live and feel. The definition given in Jackson's Glossary of Botanic Terms (3rd ed. 1916)—"a vegetable production, nourished by gases or liquids and not ingesting solid particles of food"—is even more unfortunate. The text-books are still more vague, commonly not even attempting a definition, but plunging abruptly into a discussion of the special characteristics of plants.

In the belief that a concise, clear-cut definition of the term is of very definite value to the beginning student, the writer ventures to present to his colleagues for their criticism the following definition which he has been using in his classes: *A plant is an organism possessing chlorophyll or descended from chlorophyll-possessing ancestors.* This definition, given at the outset, makes the method of nutrition the primary basis for distinction between the two groups, the other differences being naturally presented as in large measure the consequence of this fundamental difference. At the same time, it provides for the inclusion of the non-green plants and places significant emphasis, at the very beginning of the course, upon the idea of evolution. Bacteria, except possibly certain of the higher filamentous forms, are excluded. In view of the power of chemosynthesis possessed by certain members of that group, and of the very plausible possibility that they antedate any distinction between plant and animal life, this is desirable. The present equivocal position of the slime moulds is not affected.

This definition is not presented with the expectation that it will prove entirely satisfactory, but rather with the hope that it will call forth a better. Possibly such a definition has already been published. If so, it has been strangely overlooked by the writers of our textbooks.

GEORGE W. MARTIN

RUTGERS COLLEGE

MUSCA LINNÆUS, 1758, AND CALLIPHORA DESVOIDY, 1830

IN accordance with the Rules of the International Zoological Congress, the attention of the zoological profession is invited to the fact that Dr. L. O. Howard, W. Dwight Pierce and twenty-one other professional zoologists have requested the International Commission on Zoological Nomenclature to exercise its plenary power in the case of the Linnæan genus *Musca* 1758, and, under suspension of the Rules, to declare *M. domestica* as type of this genus, also, under suspension of the Rules, to validate *Calliphora* Desvoidy, 1830, with *C. vomitoria* as type.

The request is based on the grounds of practical utility, and an almost unbroken history of consistent usage since 1758 in the case of *Musca*, and since 1830 in the case of *Calliphora*. It is claimed that a strict application of the Rules will produce greater confusion than uniformity.

According to the premises at present before the commission, if the Rules are strictly applied, the generic name of *Musca* would take either *M. cæsar* or *M. vomitoria* as type, and the species *M. domestica* would be cited either in *Conostoma* 1801 [?] (type *Ascaris conostoma* = larva of *M. domestica*) or in *Promusca* 1915 (type *M. domestica*), thus resulting in a very regrettable change in the nomenclature of the species in question as almost universally used in entomological, zoological, medical, epidemiological and veterinary literature.

The secretary of the commission invites any person interested in these cases of nomenclature to communicate his opinion on the subject as soon as possible, and not later than May 1, 1918,[1] when the subject will be submitted to the commission for vote.

C. W. STILES,
Secretary to Commission

TWENTY-FIFTH AND E STREETS, N. W.,
WASHINGTON, D. C.

THAT CHEMICAL "CRAMMING" MATCH

PROFESSOR JACOBSON'S spelling match, a cue word device adopted by many students when cramming up for an examination, prompts me to record a remark made a quarter of a century ago by one of our greatest chemists. Said he "I once had a student who could repeat every chemical formula in all the books, but I never could teach the damned fool a thing about chemistry."

W. J. HUMPHREYS

WARNING

A MAN calling himself Walter F. Clarke and representing himself as my nephew is reported as seeking financial accommodation from my colleagues throughout the country. I have no such nephew and I know no person of that name.

JOHN M. CLARKE

STATE MUSEUM,
ALBANY, N. Y.

QUOTATIONS

THE NEW FRONTIERSMEN

THE comments received regarding the reports in the *Times* of the meeting of the American Association for the Advancement of Science are such as to give encouragement to those men of science who are the new frontiersmen of our civilization. They are the men of the lens and the meter, of the balance and the crucible, of the magnet and the spectrum, of the atom and the electron, of the syllogism, the equation, the theorem, the statistic. They are no less the frontiersmen, the precursors, than this republic's early pioneers of the axe, the plow, the rifle and the saddle. They who have patiently enlarged the borders of truth are as deserving sons of democracy as they who have pushed out the physical bounds between the desert and the sown.

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[1] On account of delay caused by the war, final vote will not be taken until about January 1, 1924.

Day after day, these new pioneers—frontiersmen even in the midst of the great cities—are out in search of bacteria, which are what the wild beasts or savages were to the early settlers, or the elusive element or the invisible principle or the pervasive but unformulated law. And night after night they venture forth over the universe's quadrillions of miles as hunters in the skies to bring back fresh bits of stellar truth to the earth. To rank such service with that of the old frontiersmen of the western solitudes and to let its findings take their place in the most important news of the day is one of the very encouraging signs in a democracy about which so many disparaging observations are made.

The privation of the new frontiersman is not as a rule that of living far from neighbors and friends, of enduring untempered cold or withering heat, or of going without sufficient food. It is the hardship of holding one's self to a course of study or research that will lead out beyond the edge of the known, the privation of denying one's self every comfort to find what the truth is and the suffering of following wherever the truth leads. When the public put such men among their greatest citizens, as the people of France put Pasteur, there need be less anxiety about democratic ideals. But the scientists should take the great public into their confidence. If the scientist have not the ability to speak to the people, then he should have in his city laboratory or his field tent with him an interpreter, the reporter, one who can "merge scientific facts into new human relations." The reporter must also be a frontiersman.—*The New York Times.*

SCIENTIFIC BOOKS

The Mineralogy of Pennsylvania. By SAMUEL G. GORDON. Special Publication No. 1, The Academy of Natural Sciences of Philadelphia, 1922, 255 + xiv pp., plate and text illust. 8vo.

"The Mineralogy of Pennsylvania" gives in an exceptionally clear and concise way all the essential data as to the geology and mineralogy of the state. The crystal forms are not only described but well illustrated, and for each of the many minerals one or more of the best analyses are presented. The book opens with a graphic historical outline. The first great inspiration to the science in Pennsylvania might be said to date from the pilgrimage made to the laboratory of Abbe Haüy in Paris by several Pennsylvania students, notably Adam Seybert, Gerard Troost (a native of Holland), and later by Lardner Vanuxen and William Keating, whom we may regard as the first scientific mineralogists of America. A powerful aid to the development of the study was the fine collection of minerals brought back from Europe by Adam Seybert.

The founding of the Chemical Society in Philadelphia in 1792, marks one of the earliest stages in this science and that of mineralogy in the United States. Following this came the organization of the Academy of Natural Sciences of Philadelphia, the first mineralogical accessions being some artificial crystals prepared by Dr. Troost. Later, Seybert's collection was acquired, and was lectured upon by Troost. Contemporaneously, in 1812, Isaac Lea published "An Account of the minerals at present known to exist in the vicinity of Philadelphia"; four years earlier, in 1808, Adam Seybert had issued his "Catalog of some minerals which are found in different parts of the United States." It is impossible to overestimate the inspirational value of these early writings.

"The Origin and Occurrence of Minerals" are treated on pp. 11-22. A synopsis of the classification of minerals according to their occurrence by Wherry and Gordon is given, followed by a discussion of each kind of deposit, with lists of the minerals of each assemblage. A new arrangement of the well-known classification of rocks after Rosenbusch, Kemp and Iddings is presented. Data of this chapter are not available elsewhere. General Geology of Pennsylvania: Here, on pp. 23-24, the geologic formations of the state are tabulated, with notes on the character of the rocks and their minerals. This is the most up-to-date and complete statement of the geology of the state that is available.

One hundred and fifteen pages (34-149) are devoted to a detailed description of about two hundred and fifty minerals found in the state. After the heading of each mineral, in which name, composition and crystal form are stated, the mineral is described in the following order: color, lustre, form, hardness, specific gravity, and then crystallography, composition and localities in Pennsylvania. A large number of crystal figures illustrate this part.

The mineral localities are listed according to counties and thence according to townships (pp. 150-240). After a statement of the exact situation of a locality, based on Kemp's Coordinate System, the geology is briefly noted, followed by annotated lists of the minerals of the localities arranged usually in a genetic order, with complete references to the literature. On p. 176, Wheatly mines, there is a typical illustration of this method of arrangement. The date and place of the first publication of discovery is everywhere given.

Pennsylvania has been, strictly speaking, more a state of mineral collectors than any other in the United States. This centered about the city of Philadelphia for a period of fully sixty years and, although the men frequently were scientific mineralogists, yet they were intelligent collectors and did not confine themselves only to Philadelphia and the many localities about it, but brought together collections of the finest minerals in the world, notably the Clarence S. Bement Collection, forming the main part of the Morgan-Bement Collection of the American Museum of Natural History, the finest private collection ever gotten together.

Many of these collectors met at the home of the late W. S. Vaux on Saturday afternoons, and at the home of Clarence S. Bement on Sunday afternoons, for the exchange of ideas and to study the minerals and sometimes to exchange specimens.

Among these men were Colonel Joseph Wilcox; Dr. Joseph H. Leidy, the great biologist, who formed a fine collection of gems and several collections of minerals; George W. Fiss, who drifted into microscopic mineralogy; J. M. Cardeza, of Wilmington; Joseph Wharton, who founded the Wharton School at the University of Pennsylvania; John Hancock, whose collection was acquired by the Holden Fund for Harvard University; T. D. Rand; W. W. Jefferis, whose collection is now in the Carnegie Museum in Pittsburgh; Dr. George A. Koenig, who discovered the diamond in the Canyon Diablo meteorite; Dr. Joseph Genth, who analyzed many minerals, frequently with results that gave us original species. Thus we have the minerals, jefferisite, genthite, bememtite, footeite, randite, wilcoxite. There were a number of dealers, among the most important of whom were the late Dr. A. E. Foote and Joseph Pennypacker, of West Chester, Pa.

Wharton gave his name to the Wharton School, and W. S. Vaux[1] left his collection to the Academy of Natural Sciences in Philadelphia, and the Vaux collection was the pride of the academy's splendid display of minerals.

Had it not been for this early interest in mineralogy and the number of interesting localities in Philadelphia and the nearby region, this group of collectors would not have materialized, and mineralogic science would be without the many collections which came through them.

The magnificent pyrites and associated minerals from French Creek, the garnets and beryls from Avondale, the felspar from Media, the amethyst from Upper Providence, the great variety of zeolites from Philadelphia and its vicinity, the minerals of Delaware County, the pyro-morphite and wulfenite from Phœnixville, and the millerite from the Gap Mines, grace many of the finest collections in the world.

The great collection of Clarence S. Bement (died Saturday morning, January 27, 1923, at Philadelphia, Pa.) represented not only thirty years of assiduous collecting, but the buying of many collections—fifty or more minor collections—including the selection from the entire collection of Norman S. Spang which was the result of thirty years collecting by Norman Spang (died December 10, 1922) and his father before him. The latter visited the principal localities throughout England, Germany and Switzerland every year, whereas the son, because of his health, spent his summers in the Lake Superior region and his winters in Florida, which meant that he visited all the northern localities, North Carolina, Virginia and the eastern states generally.

This collection eventually became the property of the American Museum of Natural History and really is Pennsylvania's offering to American mineralogy, as this is undoubtedly the finest collection of minerals in the United States and ranks among the two or three finest of the entire world. All the choicest specimens of the Spang collection were merged in the Bement collection by the purchaser and it is now known as the Morgan-Bement collection. Biographical notice of these two eminent collectors will appear later.

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[1] His nephew, George Vaux, inherited several dozen of the finest specimens, and has been a most assiduous collector and has financed the recent trip of Dr. Gordon to South America.

The listing of the mineral localities according to counties and then according to townships is very useful to those studying the minerals and their occurrence, and at the same time gives precise data where to look for the minerals themselves.

The bibliography of Pennsylvania's mineralogical literature is remarkably complete and there is an admirable index.

George F. Kunz

SPECIAL ARTICLES

A POCKET DISSECTING SCOPE

This new dissecting device was designed for the purpose of providing a simple and efficient instrument for examining small megascopic objects such as are encountered by the general nature lovers and students in plant and insect systems. And also to provide a small compact instrument of this kind that could be easily folded and closed up and conveniently carried in the student's pocket.

Fig. I shows a simple sectional elevation of the pocket scope in working adjustment.

Fig. II gives a view of the instrument folded and closed.

The device when adjusted for work, Fig. I, is operated by holding it in the left hand, the forefinger resting upon the knurled surface (b) of the slidable and revolvable tweezer (5), and the thumb upon the tiltable focusing block (4). By a conjointed motion of the finger and thumb thus placed it is surprisingly easy, when the lens is held under the eye, to keep the object (f) in focus while it is being picked by means of a needle held in the right hand, or, revolved by the forefinger of the left hand to secure views of the object (f), from all angles.

A forward and backward movement of the thumb pressing upon the tiltable block (4), lowers and raises the lens (1). Thus focusing is made easy.

A movement of the forefinger at right angles on the knurled surface (b), revolves the tweezer in its socket (6), thus bringing to view the various portions of the object (f).

The tweezer rod (c), being slidable as well as revolvable in its socket (6), the object (f) can be easily adjusted laterally under the lens (1).

Section (7) is a hollow tube permanently closed at each end, to one of which is attached the lens and its operatives (1, 2, 3, 4, 5, 6). This section (7) is separably and invertibly insertable into section (8), (8) being an open hollow tube inwardly shouldered at each end to limit the extent of insertion of (7) and (9).

Section (9) is a tool box composed of a hollow tube closed at one end and containing tool sockets for holding dissecting instruments (10) at the other. This box is invertibly insertable into (8).

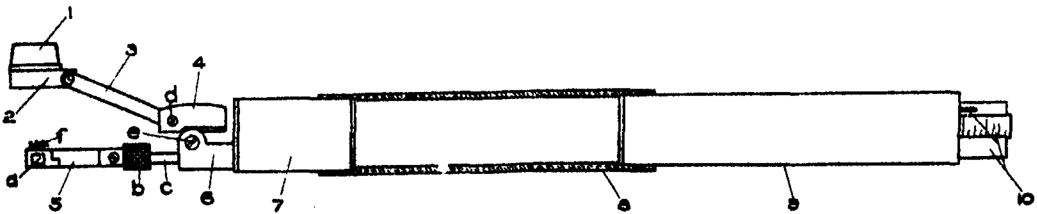


Fig. I

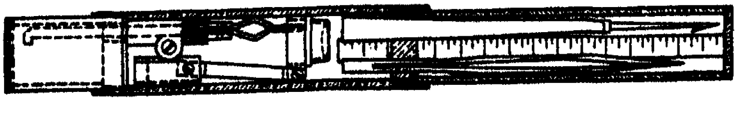


Fig. II

To change the instrument from the working adjustment, Fig. I, to the pocket adjustment, Fig. II, the lens (1), and its bar (3), is placed horizontally, then (7) is reversibly inserted so as to conceal the lens and its operatives in section (8).

Section (9) in like manner when reversibly inserted encloses the exposed tool handles (10), within the other end of section (8).

The instrument thus folded and closed, Fig. II, may be carried in the student's pocket.

The pocket scope comprises five distinct advantages for nature lovers and general taxonomists.

1. Quick general observation is easily obtainable by adjusting the lens as in Fig. I, and pushing the tweezer backwards in its socket so as to clear the space under the lens, and then using the body of the instrument, sections 7, 8, 9, as a handle.

2. Detailed observation is made easy and delightful by placing the object to be examined within the grasp of the tweezer jaws where it can be held firmly in an easily shiftable position for dissection.

On one jaw of the tweezer is a shallow cup (a), on the face opposite (a) is a fine sharp needle point.

The cup may be used when examining spores or small seeds, the needle point may be used for holding small insects, etc.

3. The right hand is free for picking the object and recording the facts observed.

4. The dissecting instruments are pleasingly accessible at the rear end of the scope (10).

5. When the dissecting or observation is completed the scope may be easily closed up and conveniently carried in the pocket.

Elmer Grant Campbell
Purdue University

A SIMPLE RECORDING SPIROMETER

In carrying on various metabolism experiments in our laboratory we have had occasion to make a large recording spirometer which is so simple in construction and easy to manipulate that we are describing it, hoping that other workers may benefit thereby.

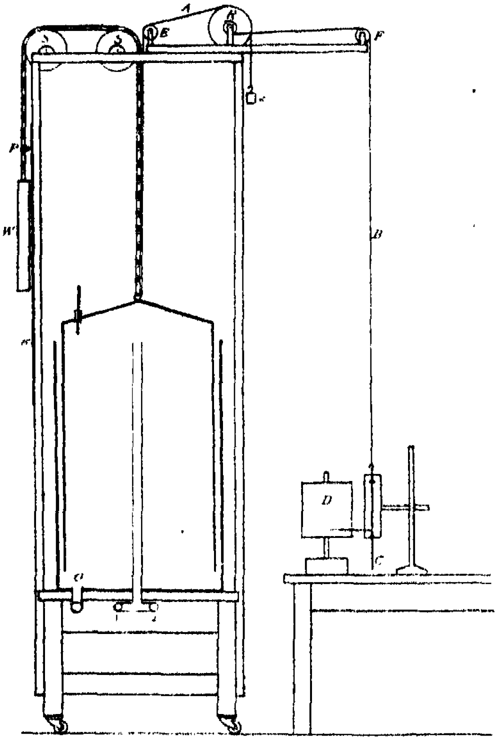
The outer tank consists of a large garbage can with inlet (I) and outlet (O) tubes one inch in diameter each provided with large stopcocks. The inlet tube has two vents (1 and 2) which facilitate emptying the air without disconnecting the breathing tube.

The float tank is made of thin sheet zinc and holds about 110 liters. A thermometer (T) records the temperature of the expired air.

We have made use of a much more simple plan than any spirometers we know of, to compensate for the additional weight of the float tank as it rises.

The Tissot type is cumbersome and should the tank fill rapidly complete compensation may not occur owing to the size of the siphon tube. The eccentric pulley type throws the line of support off center unless prevented by additional pulleys.

Our support consists of a roller sprocket chain. The weights, *W* and *w*, exactly balance the float tank when it is submerged. The large weight is made of water pipe which is closed at the lower end. This makes possible the addition of shot until a correct balance is obtained. As the tank rises its additional weight is compensated by fewer links on the tank side and added links on the weight side. Weight is thus



gradually taken from the tank side and added to the weight side at a rate which maintains uniform balance. The size of the chain therefore depends on the size and thickness of the float-tank. In our instrument an ordinary roller bicycle chain is just sufficient to compensate.

The recording device consists of two threads so placed as to lift a stylus which records on the drum. One thread (*A*) is attached to the top of the float-tank and passes over two pulleys, *E* and *R*. This thread is kept taut by a small weight (*w*) of 25 or 50 grams. A second thread (*B*) is wound around a bobbin on wheel *R*, passes over pulley *F* and is attached to a light rod, *C*. This rod slides easily in a vertical direction and carries the writing stylus. As the float-tank rises, wheel *R* is turned round and the writing stylus lifted. The ratio of the circumference to the bobbin of pulley *R* is such that when one liter of air enters the spirometer the writing stylus is lifted one millimeter. The record thus shows not only the rate at which the tank is being filled and the number of expirations, but also the amount in liters of air at any time as represented by the number of millimeters the stylus has risen from the base line.

All the pulleys turn on cone bearings, which reduces the friction to a minimum. The roller chain is well oiled and offers very little resistance. The whole apparatus is so sensitive and so easy to manipulate by students without special training that we recommend it to others for general laboratory use.

J. R. SLONAKER

PHYSIOLOGICAL LABORATORIES,
STANFORD UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE BIOLOGICAL SCIENCES

THE AMERICAN SOCIETY OF NATURALISTS

President, William M. Wheeler.

Secretary, A. Franklin Shull, University of Michigan, Ann Arbor, Mich.

(Reports by A. Franklin Shull and Herbert W. Rand)

The sessions of the American Society of Naturalists presented two unified programs. One was in celebration of the one hundredth anniversary of the birth of Francis Galton and Gregor Mendel, two outstanding figures in the development of biology, particularly genetics, in the past sixty years. The speakers on this program were E. M. East, T. H. Morgan, J. Arthur Harris and George H. Shull. The other program of this society was a symposium on geographic distribution of animals.

The annual dinner was one of the most successful and most largely attended the society has ever had. Following the dinner, Professor W. M. Wheeler, of the Bussey Institution of Harvard University, gave his presidential address on "Academic biology." At the close of the address Professor C. H. Eigenmann, of Indiana University, called upon informally, sketched a dream of a recent visit to Hades. He found that scientific men, condemned to this lower region by their mundane brethren of orthodox faith, had introduced an extensive refrigeration system and, by application of their scientific knowledge, had otherwise so improved the old place that living conditions were really better than in the abode of the blessed.

THE ECOLOGICAL SOCIETY OF AMERICA

President, Forrest Shreve.

Secretary, A. O. Weese, James Millikin University, Decatur, Ill.

(Report by A. O. Weese)

The Ecological Society of America held three independent sessions and three joint sessions, including a symposium on "Geographical distribution" with the American Society of Zoologists and the American Society of Naturalists. Joint sessions were held with the American Society of Zoologists and the Botanical Society of America. The Wednesday afternoon session was devoted to a program of papers presented by invitation and covered many of the phases of modern ecology. The following papers were of special importance: "The utilization of energy by plants," by E. N. Transeau; "Insects affecting stored food products as a source of ecological data," by Royal U. Chapman; "The recent ecological history of Glacier Bay, Alaska," by William S. Cooper; and "Maintenance of wild life in our national parks," by C. C. Adams.

The Thursday afternoon session was devoted to the reading of papers on aquatic problems, which were especially well represented in the program for this meeting. Copies of the *Bulletin* of the Ecological Society containing abstracts of papers may be obtained from the secretary.

At the business session the further support of the journal *Ecology* was provided for by an increase of dues to $4. The committee on the preservations of natural conditions reported that the *Naturalists' Guide* was approaching completion and asked for the appointment of a sub-committee to take care of the final phases of publication. Steps were taken leading toward the appointment of a committee to investigate the possibilities in regard to the preservation of the Glacier Bay region, Alaska, the value of which has been made known to the society by the work of Dr. William S. Cooper. The constitution of the proposed union of biological societies was ratified. The following officers were elected: *President,* Charles C. Adams, N. Y. State College of Forestry, Syracuse, N. Y.; *vice-president,* G. A. Pearson, Fort Valley Experiment Station, Flagstaff, Ariz.; *secretary-treasurer,* A. O. Weese, James Millikin University, Decatur, Ill.

THE AMERICAN MICROSCOPICAL SOCIETY

President, N. A. Cobb.

Secretary, Paul S. Welch, University of Michigan, Ann Arbor, Mich.

(Report by Paul S. Welch)

The American Microscopical Society offered no program of papers, but held a business session only. The meeting included reports of the treasurer, custodian and secretary. The following officers were elected: *President,* Professor Chancey Juday, University of Wisconsin; *first vice-president,* Dr. B. H. Ransom, Bureau of Animal Industry; *second vice-president,* Dr. W. W. Cort, Johns Hopkins University; *secretary,* Professor P. S. Welch, University of Michigan; *treasurer,* Dr. William F. Henderson, University of Pittsburgh; *elective members of the executive committee,* Professor George R. La Rue, University of Michigan, Professor Z. P. Metcalf, N. C. State College of Agriculture and Engineering, and Professor E. M. Gilbert, University of Wisconsin; *Representatives on the A. A. A. S. Council,* Dr. B. H. Ransom, Bureau of Animal Industry, and Professor Paul S. Welch, University of Michigan; *Member of the Spencer-Tolles Fund Committee,* Dr. N. A. Cobb, Bureau of Plant Industry.

JOINT GENETICS SECTION

(The Botanical Society of America and the American Society of Zoologists)

Chairman, H. S. Jennings.

Secretary, L. J. Cole, University of Wisconsin, Madison, Wis.

The geneticists met first for a discussion of the problems connected with fundamental research in the various agricultural institutions. This discussion was led by Professor John W. Gowen, of the University of Maine, and by Dr. E. W. Lindstrom, of Iowa State College.

The formal papers followed in the joint section of plant and animal genetics. A general tendency has been toward the attempt at modification of heredity by various environmental agents. There is indication that the course of hereditary transmission may be modified by such agencies as X-rays, as in the work of Dr. J. W. Mavor, who has been able to modify the distribution of hereditary factors in flies, and of Dr. C. C. Little, who has produced abnormalities in eyes, jaws and legs of mice, some of which are apparently inherited in a Mendelian manner. In the jimson weed, C. Stuart Gager, working in cooperation with A. F. Blakeslee, has brought about an increased number of mutations by the use of radium; and F. B. Hanson reported on the effects of alcohol on rats, with positive results in modification of sex ratio, litter size and body weight.

Hereditary differences in tendency to produce certain types of variation were also reported upon. Dr. Sewall Wright showed a series of head abnormalities in guinea-pigs which occurred in twenty per cent. of the individuals of one line, about two per cent. in another, and not at all in others. Dr. A. A. Banta showed fluctuating variability in head form in water-fleas, Dr. P. W. Whiting reported on his investigations in the analysis of fluctuating variability in wing veins of parasitic wasps.

Papers on the control of sex were reported by Dr. A. A. Banta in water-fleas, and by Dr. Oscar Riddle in pigeons; and Dr. Heman L. Ibsen brought together extensive data on sex-ratio in guinea-pigs. A number of papers dealing with complications in Mendelian heredity were presented. Dr. C. B. Bridges showed the results of transposition of a part of one chromosome on to another, and Dr. A. Weinstein presented the method of measuring interference in linkage relationships. Dr. H. J. Muller described an efficient and practicable means of measuring the rate of mutation which may, with favorable material, make this difficult problem as easy as Mendelian analysis has been in the past.

Dr. C. E. Allen described a case of inheritance of a gametophytic character in *Sphærocarpus Donnellii.* This was of special interest, as it represents the first observed case of this type of inheritance. Dr. E. W. Lindstrom discussed two types of endosperm defects in maize. One, in Golden Bantam variety, acts as a simple recessive-defect, while the other in Yellow Flint corn, also recessive, is completely linked in inheritance with albino seedling character. In a second paper Dr. Lindstrom reported work done with Drs. L. J. Cole and C. M. Woodworth on selection for quality of oil in soy beans. High and low selection for drying quality of soy bean oil resulted in a significant separation of the two selection lines. Observations made by Dr. Karl Sax indicate that chromosomal relationships in *durum* and *vulgare* wheats are such that the possibility of ever combining their desirable qualities is very slight. Genetic results dependent upon multiple chromosome complexes in Datura obtained by Dr. A. F. Blakeslee and others were also presented. Dr. G. H. Shull presented evidence for partial linkage in *Œnothera.* This is contrary to the predictions of certain cytologists who had stated previously that crossing-over would not be possible in *Œnothera* on account of absence of synapsis.

THE AMERICAN NATURE-STUDY SOCIETY

President, William G. Vinal.

Secretary, Mrs. Anna B. Comstock.

(Report by Mrs. Anna B. Comstock)

The seventeenth annual meeting proved to be the most extended and in many ways the most successful in the history of the society. The program consisted of nineteen numbers, completely filling the sessions of two days. It was quite remarkable that every one listed on the program was present and gave his or her address at its allotted time, except for a ten-minute talk by Professor Schuyler Mathews, who was ill and unable to attend the meeting.

Thursday morning Professor E. L. Palmer, of Cornell University, gave a vivid and comprehensive talk on the rapidly increasing use of nature-study in the various scouting organizations. Professor Palmer has done much work with the Boy Scouts and has adapted many valuable nature lessons for their use, so he spoke with full knowledge of the subject.

Miss Annie T. Washburn, supervisor of nature-study in the Princeton, N. J., schools, described some projects which she had inaugurated in the schools of Princeton, where many pupils from the rural districts attend. The pupils visited and studied the methods used in a model dairy and also those of a model farm; especially interesting was her account of the beginning and growth of the annual school fair which this year exhibited garden products, flowers, poultry and farm animals; her description of the way the difficulties of housing the exhibits were met and conquered was most inspiring.

Dr. Walter Wilson, of the biological department of Brown University, gave warning of dangers in much of our routine nature-study that pupils were not attracted to science as they should be and would be if the teaching were more vital.

The question, "What do I expect that nature-study should do for my child?" was discussed by a clergyman and a physician. The Rev. G. Manley Townsend, of Medfield, Mass., declared that the supreme thing that he expected of nature-study was that it should enrich and broaden the life of his child and made a stirring appeal for breadth in nature contacts. Dr. Henry P. Lovewell, of Providence, R. I., made a plea for nature-study as a means of improving the health and the practical knowledge of the child as well as of cultivating the senses.

Dr. George W. Field, of Sharon, Mass., gave an extensive discussion of nature-study in its relation to national problems of conservation. Dr. Field spoke from the fullness of his experience as a member of the Biological Survey in charge of the Federal and Game Reservation and from his experience in Brazil. He outlined the many ways that nature-study may assist in practical conservation and also in moulding public opinion.

Professor Van Evrie Kilpatrick, director of school gardens in New York City, maintained that all of the various organizations of nature-study and gardening be combined and work together under the name of nature education. Anna Botsford Comstock, of Cornell University, supplemented this by explaining the work of certain courses given at Cornell which combined gardening and nature-study.

The Friday morning session began with a most enlightening review of the phases of the growth of nature-study by that veteran in the field, Professor Arthur C. Boyden, principal of the State Normal at Bridgewater, Mass. He traced the zigzag progress of the movement in a masterly manner and gave his very cogent reasons for his confidence in its future use and development.

Mr. Charles M. Lamprey, director of the Model School of the Boston Normal School, gave a most practical talk upon the growing of bulbs both indoors and outdoors. He gave the reasons for growing bulbs in schoolhouse and garden and told the types of bulbs best fitted for this purpose and methods of treatment.

Professor Clarence E. Allen, director of the Country Day School, Newton, Mass., gave an illuminating address on the opportunities the day school offers to interest the sons of wealthy parents in wholesome out-of-door activities that may lead to an interest in the sciences and the problems of conservation and other subjects of public interest.

Miss Breta W. Childs, teacher of nature-study in the Normal School at Worcester, Mass., gave a practical and helpful address upon the need for gardening as an intermediate grade subject in city schools. Miss Childs illustrated her argument with her personal experiences, which were most convincing and helpful.

Mr. Charles S. Preble, teacher of nature-study in the Normal School at Farmington, Maine, gave methods for correlating the brook and pond with the aquarium and showed how the study of the one led to the study and understanding of the other. His suggestions were detailed, practical and helpful.

Miss Gertrude B. Goldsmith, teacher of nature-study in the Normal School of Salem, Mass., gave a scholarly and thoughtful address on nature-study as a means of education for leisure.

The Friday afternoon session began with an interesting address by Miss Fannie A. Stebbins, supervisor of nature-study, Springfield, Mass. Miss Stebbins gave a detailed account of the project carried on by her pupils which was termed the Bird Hospital. The most interesting patient in this hospital was a lamed heron; the children in feeding and caring for their patient made field studies of insects, toads and frogs, fishes and many other creatures and learned much of their habits and environment; they also became acquainted with the game laws and staunchly defended them. Miss Stebbins showed conclusively that if one phase of nature be well studied, it leads to other phases.

Miss Pearl McCoy, teacher of nature-study at the Bridgewater, Mass., Normal School, gave a clear-cut and wise talk upon the proper correlation of nature-study with English composition. She stressed the oral exercises and the child's interest in telling about his pets or his observations of birds and animals in the field.

Dr. Marion D. Weston, of the Rhode Island College of Education, discussed the value of nature hobbies to people in general, and gave many practical suggestions as to methods of interesting people in special lines of plant or animal study, all based upon her own experience in the Rhode Island Field Naturalists' Club.

Mrs. Helen H. Neal, who is a director of nature lore in the Gulick camps, spoke with great earnestness of the importance and methods of interesting young children in nature.

The session ended with an illustrated lecture on John Burroughs by Dr. G. Clyde Fisher, of the American Museum of Natural History. Dr. Fisher had the privilege of a long and intimate association with Burroughs and has used his skill as a photographer with great success. The slides were made from Dr. Fisher's negatives and colored by an artist and are as vivid in portraying scenes in the life and surroundings of the great naturalist as they are intrinsically beautiful. Dr. Fisher's talk was full of interesting personal recollections of Mr. Burroughs and a fitting accompaniment for the pictures. It is most fortunate that through the devotion of Dr. Fisher we have this living monument to the life of the one whom all of us love through his books.

On Thursday evening more than fifty members of the society gathered at the Bellevue to take part in the dinner given in honor of their long-time secretary, Mrs. Anna B. Comstock. Dr. Clarence Weed, principal of the State Normal at Lowell, Mass., was a most happy toastmaster, and Dr. L. O. Howard, U. S. entomologist, and Dr. Vernon L. Kellogg, head of the National Research Council, were the chief speakers. The following also spoke: Dr. W. G. Vinal, Dr. G. W. Field, Dr. Maurice Bigelow, Dr. E. L. Palmer, Dr. G. C. Fisher, Miss Theodosia Hadley and Professor J. L. Randall.

Professor William G. Vinal, of the Rhode Island College of Education, was reelected president for the coming year and Mrs. Comstock was elected secretary editor.

SECTION K—SOCIAL AND ECONOMIC SCIENCES

Vice-president and Chairman, Henry S. Graves.

Retiring Vice-president, James Mavor.

Secretary, Frederick L. Hoffman, Babson Institute, Wellesley Hills, Mass.

(Report by F. L. Hoffman)

The program of the Section of Social and Economic Sciences was thoroughly representative of the subject matter under consideration, "The more effective conservation of our natural resources."

The introductory address by the retiring vice-president, Professor James Mavor, of the University of Toronto, was a very thoughtful contribution on the question, "Certain economic reactions of the war." The paper considered the growth and movements of population, the development of transportation, movements of prices and currency statements, wages and conditions of labor, movements of capital, public opinion regarding the limits of the functions of the state, etc.

Regarding state functions, Professor Mavor said in conclusion that "not all, but nearly all of these emergency functions have since been removed from the state, in spite of a certain amount of protest on the part of those who adhered to the policy of collectivism. The practical experience of the exercise of a policy of nationalization and national control seems to have been, on the whole, adverse to that policy." And finally that "while the war has thus exercised an influence in numerous economic fields, and while in some of these the influence has been important, it is essential to attribute to the war and to the peace which followed, only those reactions which clearly can be traced to them."

The second paper, which attracted nationwide attention, was on "The conservation of human energy," by Dr. Thomas S. Baker, acting president of the Carnegie Institute of Technology. One particular phase, which was much appreciated, was the statement that "optimism is an essential in the conservation of our present stock of human energy, if by this we mean the power that has produced and is keeping alive our present civilization."

The morning session of December 27 concluded with two strong papers on "The conservation of labor power through insurance," by Mr. W. F. Chamberlain, of Hartford, and on "The conservation of health," by Dr. Eugene R. Kelley, state health commissioner of Massachusetts.

Wednesday afternoon session, held jointly with the Section of Agriculture, brought forth a very stimulating address on "The conservation of the qualities of the rural population," by Dr. Kenyon L. Butterfield, president of the Massachusetts Agricultural College; and one on "Home economics," by Dr. C. F. Langworthy and Dr. Helen W. Atwater, of the States Relation Service, Washington, D. C. Dr. Butterfield summarized his conclusions in the statement that "education and organization should seek not alone the special group interests of farmers, but should quite as consciously endeavor to mobilize rural opinion and activities on behalf of the common needs of humanity."

The Thursday morning session was held jointly with the New England Forestry Congress and the Society of American Foresters at the State House. The papers in this session included an address on "The forests of the world," by Mr. Raphael Zon, of the U. S. Forest Service; an address on the "Economic aspects of our timber supply," by Colonel W. B. Greeley, chief forester, U. S. Department of Agriculture; a very impressive address on "Forest research and the forestry movement," by Professor R. T. Fisher, head of the Division of Forestry, Harvard University. The session also included a brief address on "State policy in forestry," by Mr. W. A. L. Bazeley, state conservation commissioner of Massachusetts. Mr. Bazeley drew particular attention to the neglect of municipalities to practice rational methods of policy, while he said that rural towns that have the largest forest area are generally the poorest and least responsive to new ideas.

The Thursday afternoon session included five papers: "The conservation of capital," by Mr. H. T. Newcomb; "The conservation of America's economic independence," by Dr. Frederick L. Hoffman; "The element of time in industrial management," by Dr. F. S. Gilbreth; "Early and economic aspects of heart disease," by Dr. Robert H. Halsey, and "Invention conservation," by Mr. James G. Dudley. The address by Mr. Newcomb was a carefully reasoned argument, suggestive of thoughtful future consideration, including much valuable material, presented with admirable clearness. He concludes with the suggestion that "what is necessary for the conservation of capital and the maintenance of civilization is renewed confidence in fundamental principles of politics and economics, and to return to the simpler methods under which this nation obtained its principal growth, and became capable of the commanding position in the world's industry and affairs."

The Friday morning session was introduced by an address by Dr. John T. Black, now conservation commissioner of the Ætna Life Insurance Company, on "Conservation and industrial waste," followed by a paper on "The federal water power policy and its results," by Mr. O. C. Merrill, secretary of the Federal Water Power Commission. In summarizing his observations, Mr. Merrill said: "Results already accomplished afford convincing evidence that grants of special privileges are not necessary, in order to secure the development of all the electric energy that the market can absorb." He strongly opposed essential modifications of the Act of 1920 and said: "Having spent many years in developing a federal water power policy, it would be most unwise even if the act were not successful, to permit the law or the policy to be materially modified, except after fair trial and convincing evidence of the desirability of change."

General Harry Taylor, in charge of government flood control work, contributed a timely address on "Problems of flood control," summarizing the results of a wide experience applied to the solution of one of our most important present day problems. He endorsed the levee system, as having proven successful, under most trying conditions, pointing out at the present time there are nearly 1,800 miles of effective levees between Rock Island, Illinois, and the mouth of Mississippi, protecting nearly 30,000 square miles, or perhaps the most fertile area in this country. He made the concrete suggestion that in locating levees care should be exercised not to place them so near the banks of the river as to unduly crowd the stream and reduce the cross sectional area sufficiently to prevent the escape of flood waters, without causing their rise to a height that would overtop the levees. Finally, he said: "It is rarely the case that a flood control problem is not of more than local importance."

At the concluding session Friday afternoon, Dr. George F. Kunz read a most interesting address on "Our scenic resources and their practical uses," followed by a strong plea by Mr. Robert Sterling Yard on "Our national park policy in its economic aspects."

The final paper on the program was an address on "The conservation of our whale fisheries," by Dr. John Franklin Crowell, vice-president-elect of the Section of Social and Economic Sciences. Dr. Crowell raised the question as to whether whaling was a vanishing industry, discussed its world-wide extent and importance, followed by observations on changes and methods in new fields, with remarks on the principal areas of the whaling industry, and an extended discussion of the world's most prolific whaling grounds in the Antarctic Ocean.

The sessions were not as well attended as the importance of the papers would have suggested, but every effort will be made to secure for all the various papers the required and suitable publicity.

The sessions were presided over throughout by Professor Henry S. Graves, Yale University, vice-president and chairman for the section. It was tentatively agreed that next year's program should follow similar lines, but present the social and economic progress of the United States since the close of the World War.

THE METRIC ASSOCIATION

President, George F. Kunz.

Secretary, Howard Richards, 156 Fifth Avenue, New York, N. Y.

(Report by Howard Richards)

The annual meeting of the American Metric Association was held according to schedule in the Massachusetts Institute of Technology on December 30, 1922.

The speakers were also entirely from the industries and included such men as B. L. Newkirk, of the General Electric Company; A. E. Marsh, of the Waltham Watch Company, Theodore H. Miller, of the De Laval Separator Company, and Walter Wood, of R. C. Wood and Company, the well-known manufacturers of pipe and other steel products. The Army was represented by Major L. A. Nickerson, Ordnance Department, U. S. A., and the Navy by Captain Eliot Snow.

The practical use of the metric system, legal for all transactions since 1866, was emphasized. By motion of Dr. Arthur E. Kennelly, the Metric League, in connection with the Metric Association, was organized. There are no dues connected with this league, membership being open to all those who sign and send to the association the following statement: "It is my purpose to use metric weights and measures whenever feasible."

Owing to increase in membership both in the United States and Canada, and the undertaking of more comprehensive work, the name of the association was shortened to Metric Association.

Among the resolutions passed were those endorsing the Britten-Ladd bill, and expressing appreciation for the increased number of associations and firms cooperating in the metric movement.

The following were elected officers for 1923: *President,* George F. Kunz; *treasurer,* Frederic L. Roberts; *secretary,* Howard Richards. Communications should be addressed to Metric Association, 156 Fifth Avenue, New York.

SECTION L—HISTORICAL AND PHILOLOGICAL SCIENCES

Chairman of the Interim Committee on the History of Science, William A. Locy.

Secretary of the Interim Committee, Frederick E. Brasch, 6963 Morton Place, Rogers Park, Chicago, Ill.

(Report by Frederick E. Brasch)

The third meeting of those interested in the history of science movement was held in the buildings of the Massachusetts Institute of Technology, Cambridge, Mass., December 27 and 28, 1922.

This meeting was the most gratifying and successful one thus far held. It was largely due to the unusual character of the symposium held jointly with the scholars interested in the history of science within the American Historical Association.

The single session of the History of Science section was composed of a miscellaneous program. Owing to the illness of Dr. William A. Locy, chairman of the section, Dr. H. W. Tyler, of the Massachusetts Institute of Technology, presided and acted as chairman *pro tem.*

Each of the papers presented at this session carried with it, besides the interesting and strong discussion, a conviction that the history of science movement has come to be an integral part of the scientific life of to-day. There were three historical-technical papers and two general history of science papers. The two latter papers emphasized the value, methods and needs of history of science instruction in our university curriculum. Dr. George Sarton, of Harvard University, and Dr. H. W. Tyler spoke from actual experience as teachers.

The second session of the history of science meeting was the joint conference. The main concept of this symposium was the "Humanizing of knowledge"—or, better, "Humanizing Science." Dr. James H. Robinson of the Rand School of Social Science acted as chairman, and opened the meeting by calling attention to the great need of a better scientific understanding of life and its environmnt.

Besides the importance of this subject, the continuity of ideas and the coherent manner in which each of the speakers contributed these ideas were the outstanding features of this session. Dr. G. H. Mead, Dr. L. Thorndike, Dr. Sarton and Mrs. M. Austin each foresee a great need for better and more science education. Dr. L. J. Henderson, of Harvard University, opened the discussion and was followed by other speakers.

As an aftermath of the joint session of the history of science, Dr. D. T. MacDougal called a special conference to be held at 7 P.M. in the Somerset Hotel. After a most delightful complimentary dinner, the group consisting of Mrs. M. Austin, Miss Amy Lowell, Dr. J. H. Robinson, Dr. L. Thorndike, Dr. G. Sarton, Dr. J. C. Merriam, Dr. H. Shapley, Dr. S. Miller, Dr. D. T. MacDougal and the secretary were joined later by other invited guests. The purpose of this conference was to discuss the best means of procedure regarding advancing the idea of humanizing knowledge.

During the sessions of the American Association for the Advancement of Science there was on exhibition a most interesting collection of apparatus, early books of the great science masters of the past, as well as portraits and prints of famous scholars. These were to be found at the Massachusetts Institute of Technology and Harvard University Observatory.

The thanks of the section committee of Section L to those members of the American Historical Association who cooperated so splendidly in working out the problems of the joint conference are here expressed. Special thanks are due to Drs. MacDougal, Robinson and Thorndike.

The newly elected chairman of Section L is Dr. Florian Cajori, the distinguished historian of mathematics and professor of the history of mathematics in the University of California, Berkeley, Calif.

CAMBRIDGE SESSION ON SOME FUNDAMENTAL ASPECTS OF PHILOLOGICAL SCIENCE

(*Report by Mark H. Liddell.*)

A special session of those members of Section L who are interested in the philological sciences was held on Friday afternoon at the Fogg Museum of Harvard University, as provided for in the general program. At this meeting three papers relating to linguistics were presented and discussed. The first paper dealt with "Some new scientific data for the study of language" and was presented by Professor Mark H. Liddell, of Purdue University, as the outcome of investigations into the physical nature of certain qualitative variations in the vowels of ordinary conversational speech under different conditions of stress or accent. His conclusions were based upon a study of records made by the very sensitive devices for sound measurement recently perfected by the research staff of the American Telephone and Telegraph Company. They showed that normal variations of accent in ordinary conversation so slight as to be incapable of detection by the ear alone were nevertheless definitely measurable in terms of corresponding variations of energy when the components of the sound waves in which they occurred were analyzed by Fourier's theorem. There followed a lively discussion of the ultimate possibility of an absolute system of phonetics based upon purely physical and objective criteria. Professor H. L. Koopman, the librarian of Brown University, then read an interesting paper entitled "The unscrambling of Babel." He illustrated and analyzed language mixtures that had arisen in the commercial intercourse of various peoples—jargons such as the Lingria Franca of the Levant, the Urdu of the Indian Mussulmans, Pidgin English and Chinook. Dr. E. S. Sapir, of the Victorian Museum of Ottawa, added illuminating comments upon the native dialects of the American Indians in relation to the Chinook jargon. In the last paper, "Wellesley experiments in the teaching of language," Dr. Christian A. Ruckmick, of Wellesley, presented comparative data as to the ease with which an enthusiastic group of his students of psychology acquired under identical teaching conditions a quite unfamiliar natural language (Danish) and an artificial language (Esperanto) of which they knew nothing when the experiment was undertaken. The results were somewhat in favor of the latter. The discussion of Dr. Ruckmick's paper turned upon the advantages of an international auxiliary language.

It was evident in this first meeting of those members of the association who are interested in phiological and linguistic science that this new branch of the association's activities is a promising field for development.

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ON THE URGENCY OF RESEARCH ON THE GREAT PORTAL TO DISEASE IN THE BODY[1]

In selecting as the subject of my address on this occasion the urgency of research in a line along which little progress has been made, I am led to do so by considerations which I think will appeal to many of my hearers. It is, first of all, one which is of transcendant importance as an antecedent to any great advance in scientific medicine in the near future. On looking over the road on which so much progress has been made in the last forty years, one cannot but be impressed with the idea that all the old lines of research have been developed as far as they are capable of yielding results commensurate with the expenditure of time and energy given to them and that we are now in the stage of diminishing returns. The record since 1880 is crowded with discoveries in scientific medicine which will preserve from oblivion those who have made them, but unless some new lines of attack on great problems are to be thrown open the record for the next thirty or forty years will not have to its credit similar achievements. A recognition that our present methods of research in scientific medicine are not to give solutions of some of the great problems in disease which still confront us is already beginning to prevail. The distinguished clinician, Sir James MacKenzie, who has been during the last thirty years one of the keenest students, on the scientific side, of clinical medicine, is so convinced that scientific medicine as now developed is not going to yield any further conquests of importance that he has been compelled to seek a new line of research which may give results which will initiate a new and great advance in medical science. The new line which he has taken is the study of the beginnings of disease in the individual, that is, a close and very careful observation of the changes in the normal condition long before the individual is impelled to consult his physician or is aware that anything is wrong with him. Sir James hopes that in this way a great amount of knowledge may be accumulated which will throw a flood of light on the origin of many of the diseases and thus inaugurate what may be justly called a great advance in medicine, comparable with any great advance made in the past.

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[1] Address of the vice-president and chairman of Section K—Physiology and Experimental Medicine, American Association for the Advancement of Science, Boston, December, 1922.

It is hardly possible to doubt that a careful study of the organs of the body as they function in the supposedly normal individual, will, if systematically pursued, ultimately give a lore that will be of inestimable value in determining a fundamentally rational treatment of disease. The application of our present clinical methods is confined almost wholly to the manifestations of disease in its more or less pronounced stages and the features of the initial stages attract the attention of only a very few clinicians. Here, therefore, is an almost fallow field, where any one who enters to work steadily and systematically may reap a worthy reward for the toil of all his years. This combined with a closer, a more thoroughly scrutinizing study of the manifestations of disease in its later stages of development would result in a very great addition to our lore of medicine, and bring us back to the ancient Hippocratic rôle of closely observing and recording which, pursued for periods during the last twenty-four centuries, has made the Art of Medicine of the Western World an ornament of our civilization.

It is, however, doubtful if there is in our generation enough of those of the class of which Sir James MacKenzie is representative to make such an immediate advance in medicine as he believes possible. Progress is due to the activities of the almost inconceivably few. All the ideas, all the knowledge which determines our outlook on the physical world and the world of life of to-day are based on the results of the discoveries and inventions of less than one ten-thousandth of one per cent. of the population of the Western World during the last three thousand years. Even in the medical profession it is the inconceivably few to whom all progress in the past has been due. The rest have accepted and applied the results of the great discoveries of the few. Of the 400,000, more or less, who in Europe and America during the last century and a half have been members of the medical profession, how many have made, as a result of their researches and observations, great additions to our knowledge of the causation and treatment of disease? I would venture to estimate not more than thirty, that is, one out of every 13,000 in the ranks. These were the pioneers in the regions of the unknown to whom we owe the great generalizations which constitute the foundations of what we call medical science. Without their achievements there would have been no advance in it during the last three centuries and medicine would still be but a lore of impossible hypotheses and theories like that which darkened understanding amongst the physicians of the sixteenth and seventeenth centuries. There were indeed others who by their observations in their own limited field of activity added fact upon fact in verification of the great generalization and who by their support of these made their general acceptance possible, but they would not have been of service in any other way to medical science had it not been for the great discoveries of the pioneers.

To extend this science to-day, to make here and there great additions to it, pioneers of the same type are still required. Are such now in training, or beginning their career, or ready to launch some new line of extension?

Sir James MacKenzie does not apparently think there are or will be such, for his Newer Medicine is to owe its achievements to organizations the members of which will devote themselves to the observation and correlation of the facts which may be gained from a continuous, systematic study of the very earliest manifestations of alteration of function which mark the commencement of disease in the supposedly healthy individual. He is apparently extremely sceptical of the value of the laboratory by itself as a factor henceforth in the advancement of our knowledge on the treatment of disease. Research on the laboratory side is carried on by workers who, he holds, are out of touch with the problems in medicine and in consequence their contributions offer little in the way of a solution of these, which must be undertaken by the physicians themselves who are in immediate contact with the problems on the purely clinical side.

It must I think be admitted by all who are in touch with the present laboratory methods associated with the diagnosis and treatment of disease that the effort spent in the development of them by a multitude of workers in laboratories and the narrow range of the results obtained make it appear as if the vast majority of investigators concerned believe the great problems that can be attacked successfully are all solved and that there remains only to be developed an ever more and more refined technique which will be concerned only with circumscribed problems such as the hydrogen ion concentration, basic metabolism, new reactions of the class of Widal, Schick and Wassermann, more exact methods for the determination of sugar, urea, uric acid, ammonia and other constituents of and metabolic products in the blood, and so on. These and like matters of limited interest and range of application constitute the vast majority of the problems which are now being investigated if the contents of the original papers published in the journals devoted to physiology, biochemistry and pathology give a trustworthy indication of the character of the research that is being carried on in these sciences to-day.

If even a new subject of more than ordinary importance is advanced there soon results a multitude of contributions on it, the great majority of which deal only with details while the central part of the problem is not attacked or only incidentally. An instance may be cited. On the vitamins, which are all important constituents of a normal diet and which were first made known sixteen years ago by Gowland Hopkins, there has been a vast amount of effort expended but chiefly or almost wholly on determining their distribution in different foodstuffs and the effects of diets, from which they are absent, on animals, all in a statistical or empiric fashion, while but little has been attempted or accomplished as to their constitution although a basic explanation of their action in the body can only be obtained when their chemical composition is accurately known.

Then there is the labor that is directed to the determination of hydrogen ion concentration in physiological media. From a survey of the multitude of contributions on this subject which have been made in the last five or six years one cannot but believe that an excess of emphasis has been placed on it which is not justified by the results obtained or any generalizations drawn from them. As much also may be said of the work that is done on a number of problems in immunology.

It must not be inferred from what has been said that I underrate the real value of the results of much of the work that has been done in these lines. I recognize that they have a value, but a value that is not commensurate with all the effort expended in obtaining them for it involves an emphasis on details which should be placed on important problems the solution of which would open new and fundamental lines of development in our knowledge of living matter in its normal condition and in disease. The emphasis placed on details is diverting the energies of a large number of young workers of promise away from the more important problems in the investigation of which they might develop a capacity for adding very greatly to our knowledge and thus achieve a career of distinction in research for themselves. This attention to details on such a large scale at the present time can be justified only on the plea that all the great or more important problems are solved. Even if they did appear to be, it is difficult to believe that a young potential Pasteur, Virchow, Lister, Koch, or Ehrlich would content himself with the investigation of such details and yet I believe there are such potentialities amongst the younger generation of researches who may easily be induced to devote all their energies to problems of outstanding importance.

It may be asked: Are there such important lines of investigation yet to be undertaken? My answer is that there are, and not a few, and that, further, more may eventually be found than are now conceived possible. The chemical constitution and the fundamental action of the vitamins are two of these. There are the questions concerning the nature and action of the bacteriophagic lysins, our knowledge regarding the existence of which is the product of the activities of several keen young workers during the last seven years. The interpretation of the character, origin and action of these lysins in dissolving bacteria will ultimately depend on the results of research to be carried on in the next few years. Meanwhile, it would appear that the bacteriophage is a factor in immunity, especially in the intestinal tract, which may not be classed with the antibodies which hitherto have been regarded as the only or chief immunizing substances produced in the body to resist bacterial invasion. The bacteriophage question has, therefore, thrust on our attention problems of a high order of importance.

Behind all these problems there are at least several which concern the causation of a considerable number of pathological changes and alterations in function in the organs of the body. These problems are all related to the functions of the intestinal mucosa. Such functions are only very imperfectly known. One involves the absorption of the products of the digestion of the foodstuffs. In this absorption the mucosa has been, and is still too often, regarded as if it were only a physical membrane separating the blood from the intestinal contents, through which the peptones, amino-acids, glycerine and sugars diffuse to reach the vascular channels. What we have to set over against this physical concept are a few facts the significance, however, of which is not clear. Soaps and fats which are colloids enter and go through the epithelial cells of the mucosa and a number of proteins, those of egg yolk particularly, pass unchanged readily into them, but how the former and the latter are so taken up is still unknown or only dimly comprehended. The salts of iron and potash can be traced microchemically in their passage through the epithelium and the phenomena involved appear at first view to be caused by the simple forces of diffusion but on further consideration one must postulate that other and more important factors are concerned. We know, further, that the mucosa, especially of the upper half of the small intestine, secretes a number of ferments, such as erepsin, invertase, maltase, lactase, and the activator of trypsinogen, enterokinase, and that secretin, the hormone of the pancreas, is a product of the duodenal mucosa, but, except in the case of secretin, we do not know definitely what elements of the mucosa form them.

This, in brief, comprehends our knowledge of the activities of the intestinal mucosa and yet how exiguous it is in comparison with what may yet be obtained through careful and well-directed research. The mucosa is, in its properties and functions, something very much more than a physical membrane. Because its superficial layer is composed of living cells it is not, it cannot be, a passive element, for the cells have, as living units always have, the capacity to accept or reject whatever constituents of the chyle there may be and this capacity is exercised by them through the long life of the individual. They even maintain themselves against the invasion of bacteria of the ordinary type.

This epithelial membrane then has functions which make it unique, functions which are not performed by any other organ. It is the absorbent of practically all that goes to nourish the body, a rôle that involves a variety of activities assigned to no other class of cells in the body. It prevents also the passage through it of the ordinary bacteria of the intestinal cavity and of their products, toxic and otherwise, and therefore it must be regarded as the first line of defense of the body, at its most vulnerable point, against disease. As no other structure in the body is so much exposed, and constantly to bacteria and to invasion by them it is difficult to exaggerate its importance in this respect.

That the cells constituting this membrane, battling against hosts of bacteria and subject to the action of the products, many and varied, of putrefactive fermentation, may finally fail to "play up" must naturally be expected. Then pass into the circulation some or all of those elements which the cells in their fully normal condition do not absorb, or if they do absorb, do not transfer to the underlying tissues.

It is not too much to say that in this failure on the part of the epithelial cells an explanation may be found of the origin of a large number of diseases of the body. It is my firm conviction that arteriosclerosis, hepatic cirrhosis, acute yellow atrophy of the liver, nephritis in some of its forms, angina pectoris, senile dementia and dementia precox are all due to failure, more or less pronounced, on the part of the intestinal epithelial cell to play its normal part. In some cases this failure may develop suddenly as in acute yellow atrophy, in other cases it may involve a gradually lessened capacity of the epithelial cell to reject or neutralize the products of putrefactive action. That dementia precox has this origin is indicated by the facts that it is frequently associated with intestinal stasis more or less pronounced and that not unfrequently in this disease there may be atrophy of the testes or ovaries, facts that can only be explained by supposing that not only this atrophy but the degeneration of the cortex are due to the action of toxins of intestinal origin. Senile dementia, when not of arteriosclerotic origin primarily, is probably due to a gradually lessened capacity of the intestinal cells to reject the toxic products of putrefactive fermentation.

The intestinal mucosa must then be regarded as the great portal to disease of the body. This portal may be completely closed as it is in the normal healthy condition of the mucosa or it may be gradually or suddenly pushed open and disease, chronic or acute, may result. If this portal could be kept closed always old age might be indefinitely postponed and bodily vigor maintained for a much longer period than it is now. There is no reason to suppose that the heart, the skeletal muscles, the liver, the kidneys, the nervous system and the endocrinous organs cannot function indefinitely if they are not subject to toxic action and in their normal condition they must be much less subject, through any other portal, to bacterial infections than they are when their condition is altered by the access of toxic material absorbed from the intestinal cavity. The complete closure of the great portal permanently maintained would greatly lessen the incidence of disease and increase the average length of life.

It is probable that excess in diet, especially in its protein constituents, may task the capacities of the epithelial cells and diminish their power to react normally, with the result that they allow to pass through them, and to the underlying tissues and the circulation, the products of intestinal putrefaction which in their healthy vigorous condition they do not permit to enter them. This would explain some of the pathological results of a high protein diet. It is also very probable that the primary and most important action of vitamins in diet is on the epithelial cells which, with the glandular structures below them, as McCarrison has found in his observations on animals fed on autoclaved food, undergo marked atrophic and necrotic changes, followed by an extensive invasion of the mucosa by bacteria. The changes which other organs show in avitaminosis have yet to be shown due directly and not indirectly to their deprivation of the vitamins. Once the Great Portal is thrown wide open, neuritis, degenerative changes in the pancreas, thyroid and spleen, atrophy of the testes and ovary, and hypertrophy of the pituitary and adrenals may be of toxæmic origin. Constipation also seems to be one of the earliest results of avitaminosis and its causation may be similarly explained.

The importance then of a thorough knowledge of the functions of the intestinal mucosa and especially of the epithelium covering it cannot be overestimated. To obtain that knowledge is to place us in a position from which we can make a great advance in the treatment of disease or in the prevention of it, comparable with any one of the great advances of the past in scientific medicine. That knowledge can only be obtained by a profound study of the epithelial cells themselves, of all the forces that are concerned in their normal activities, of the character of the proteins and other organic elements of which they are constituted, of the action of bacterial toxins on them and of their defence against them.

The attainment of all this knowledge is not to be an achievement of the very immediate future. That would require a number of specially trained investigators who would devote themselves to intensive research in this line for some years. Investigators of the kind necessary are rare. They would have to be trained as few are being trained to-day in physiology, biochemistry, or pathology and this could not be accomplished immediately. They should acquire an excellent knowledge of chemistry, organic, physical and colloidal, more especially of biochemistry, microchemistry, cytology and the physical forces that obtain and operate in, and on the surface of, fluid and colloidal systems. They must have also a good working knowledge of bacteriology and of the technique employed in immunological research. Only thus qualified would they be able to undertake research on the intestinal mucosa with any prospect of obtaining noteworthy results.

It may be held that the training of such researchers is an impossibility because it appears to postulate that each of them shall be as highly qualified in several sciences as a specialist may be in one of them. It may be admitted that the training necessary to conduct successfully research in this line must be of a more thorough kind than is undergone by those of to-day who are preparing for a career in research in any one of the medical sciences, but it is not more than can be exacted of a capable student free, but under special direction, to give attention for a few years to special branches of the several sciences, the knowledge of which is required. That there are few so trained now is no indication that none can be. The training of physiologists, biochemists and pathologists has hitherto been largely determined by chance conditions. There has been no guidance in it and too often it has been of an elementary or very limited kind. Many of those so prepared have in their own specialties done considerable service in the way of research, but the problems that remain demand of those who attack them more thorough and wider knowledge along different lines and in consequence the preliminary training must henceforth be extended to cover all the different sciences or branches of them, a knowledge of which is concerned in such research.

Such a training would qualify as well for important lines of research in pathology, bacteriology, immunology, physiology, and pharmacology, for the highly trained worker is to be henceforth as necessary in research in these fields as he is in biochemistry, otherwise the yield in results of more than a narrow significance will be very scanty. Only thus can the blight of speluneulism in the medical sciences, which is now in prospect, be prevented.

To produce these researchers is the duty which must be undertaken by those in command of the various departments of these sciences in our leading universities. They must exact of the young students under their charge a higher standard of attainment if research in the causation and treatment of disease is to achieve greatly in the coming generation. The demand for investigators of this type will be urgent and insistent in the next two or three decades and the failure to train them will reflect on those controlling the advanced teaching in these sciences.

With even half a score of such highly trained researchers working in this new field in the next few years results would be obtained some at least of which would compare in importance with those which marked the history of medicine in the last seven decades. We would then have a greatly increased, perhaps a profound knowledge of the functions of the organ which serves as the Great Portal of disease in the body. This knowledge would make possible new and highly rational lines of treatment of a large number of diseases, it would enable us to lessen very greatly their incidence and with its aid a regimen might be devised which would delay in the individual senescence, and even death, it may be, indefinitely.

The call for research in this line is urgent, for only through it is another great advance in medicine possible.

A. B. Macallum

McGill University

BAIRD, THE MAN[1]

The policy of the Smithsonian Institution under Professor Henry was to disperse as widely and freely as possible the worked-up material, and to enlist in the process of elaboration the aid and enthusiasm of every American naturalist, each in his special field.

To make this policy a success, such as it eventually became, required qualifications of no ordinary kind. Not only must the work of mediation be guided by the most advanced biological science of the time, but the individual intrusted with it must possess a spirit of impartial liberality, tempered by a sound discretion in business methods; a thorough knowledge and just estimate of men; an untiring patience to meet the peculiarities and caprices of the independent and often one-sided specialists whose cooperation was essential; a geniality to enlist the willing but unscientific collaborator; and an instant detection of humbug in every guise. Providentially for the future of natural science in this country, the need and the man met in the selection of Professor Baird. In qualifications for the work he stood preeminent—head and shoulders above any man of his time, and perhaps above all other scientific men of any time. He joined to a marvelous faculty for systematizing business a capacity for steady and continuous work only limited by his waking hours. His frank, genial and wholly unaffected manner put the scientist and the laboring man alike at ease. Always busy, he yet always seemed to have time for a friendly chat with every comer. His memory appeared an inexhaustible storehouse of facts on every subject where any desired datum lay ready for his use. He knew every specialist in the country. Not only did he hold amicable relations with scientists actually at work, but one might think there was not a school boy of extraordinary genius for birds' nesting or fishing on whom he could not lay his hands.

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[1] One of the addresses given at the meeting in commemoration of the one hundredth anniversary of the birth of Spencer Fullerton Baird, held in the U. S. National Museum on February 3, 1923.

His appreciation of the workers did not stop with the recognition of the character of their scientific results. It seemed as if in his mind he had an epitome of all the characteristics of mind and habit of each and every man. In the constant necessity of selection for this or that task or post, which the always increasing scientific activity of the time rendered more frequent from year to year, he was very rarely mistaken in his judgment. In his position he was called upon to advise in nearly all government appointments which had a scientific bearing, direct or indirect; and the total number of selections which he determined during his career must have been many hundreds, and have included nearly every available person among the younger generation of students. The most surprising element in it all, to those cognizant of the details, was the calm impartiality which he brought to the task. No thought of self seemed to enter into his calculations. To best fit the purpose was his sole criterion, the purpose always being the promotion of science, and it was a very crooked stick indeed which was not fitted by him to some honorable service, as opportunity served. Those who felt themselves the objects of his personal regard sometimes halted for a moment in comical dismay, perceiving themselves frankly moved, like chessmen, in directions which they would not themselves have selected, and did not altogether like, almost as if they were perfect strangers; but an overwhelming sense of Baird's entire devotion to the promotion of science, his perfect unselfishness, and his incomparable good judgment, always carried the day, and the final outcome never discredited his generalship.

These characteristics would have made a great administrator anywhere, but there were other elements in the problem. It is not so hard to select deputies, aids and workers of every kind when the work of the selector and that of the designated person form duly subordinated parts of a general scheme, or the parts are so constituted as to be capable of purely independent elaboration. But in scientific work, as every one knows, the spirit of emulation is strong; men work often with a single object in view, and the glory of its first elucidation is necessarily for one alone. Doubtless the substantial amity and concord which have prevailed among American naturalists is in part due to their scattered distribution, the vast and, until recently, virgin fields open to research, and the consciousness that there is plenty of work to occupy profitably every willing student and as many more. In scientific as in economic competition the rivalry grows more intense as unoccupied ground diminishes. Nevertheless, from the earliest times of American science there have been controversies, and naturally these have been more active among the leaders. Baird himself having been one of the most prolific contributors to the literature of systematic zoology in the United States, it is evident that in promoting the studies of others, and in holding as a trust for the general benefit the vast collections which passed under his control, opportunities must have been numerous for giving precedence to the progress of his own researches rather than those of others engaged in the same lines. In such cases, we believe, he never hesitated, and the decision against himself was in more than one instance known by him at the time to be of pecuniary as well as scientific disadvantage to his own apparent interests. He never spoke of this sort of self-denial, and it was in a majority of cases known but to a few persons incidentally connected with the researches in question.

If he guided the activity of others as one would use impersonal agencies in the pursuance of a definite end, he was not less exacting with himself. He not only offered freely to others, sometimes constructive rivals, the raw material of research which he controlled, but in many cases he put in the hands of those whom he thought worthy his own more or less elaborated manuscripts, to use in their investigations, thus waiving his own priority in the field. His insistence on giving full credit to collaborators of every degree, both in publications and in records, labels and reports, was proverbial. To the tyro treading with uncertain step the entrance ways of science he was ever cordial; always a friend, guide and helper. While Professor Henry lived, the affectionate loyalty of Baird to his venerable chief was an inspiration to those about him.

That this faithful cooperation would not have been a matter of course with most men, however honest in purpose and devoted to science, will be more evident when it is understood that, notwithstanding the well-known views of Professor Henry, enforced by him on every possible occasion, a great museum actually did grow up on their hands, the inevitable result of the scientific activity promoted by Professor Baird. This museum, only after years of effort, and but shortly before Professor Henry's death, came to take its present semi-independent position, such as he would originally have assigned to it. Until this was consummated, Professor Henry's anxieties were very great. When, by Professor Baird's persistent effort, quiet tact and unremitting labor, a distinct organization was finally effected for the museum, it was felt by Professor Henry as the greatest comfort of his declining years. The possibilities of antagonism in such a situation are readily perceptible, and nothing could testify more clearly to nobility of character in both than the fact that such differences never germinated between these faithful servants of science.

When Professor Baird succeeded to the office, it was with a modesty almost amounting to timidity that he spoke of the opportunities and duties of the post. His kindly recognition of his juniors was only changed by the shade of seriousness due to increased responsibility. Only those who were engaged with him can realize what an amount and variety of labor he willingly undertook. During the period of Pacific railroad explorations and the activity of the Hudson Bay Company's people, fired by the enthusiasm of Kennicott during his sojourn in the north, collections and correspondence poured in upon Professor Baird in extraordinary quantity. Not alone was the shedding of its horns by the antelope on the western plains, or the nesting of the canvas-back among Alaskan marshes, the theme of eager letter-writing. The professor and the ladies of his household might often have been seen among the shops seeking novels for the army officer at some isolated post, a necktie for a northern voyager, or the dress goods for a wedding to come off on the banks of the Mackenzie during the crisp Arctic September. It may be imagined that in his home life Professor Baird was altogether lovable, and we can not help saying that not the least of the benefits conferred upon American science was embodied in the influence which extended from that home upon a host of boyish students gathered from year to year under the brown towers of the Smithsonian Institution, slender as to their resources, half Bohemian as to their living, let loose with little restraint in that great disjointed village, the Washington of fifty years ago.

We have dwelt on this occasion not on Professor Baird's scientific researches, his administrative successes, his creation of organized scientific agencies, like the Fish Commission and the present National Museum, nor on the fame and honors which came to him from far and near. We have left these things, which are evident and accessible, to others, and speak here of our impressions of the genius and traits of character which moulded his life and made it truly great. The latter are embalmed in the consciousness of his contemporaries, now so few; and are chiefly unrecorded, while the former may be found in reports and statistics. Two things his experience may be said to have lacked: he never had a personal controversy, nor, so far as we have ever heard or had reason to suspect, an avowed enemy.

William H. Dall
Smithsonian Institution

THE FOUR HUNDRED AND FIFTIETH ANNIVERSARY OF THE BIRTH OF COPERNICUS

Nicolaus Copernicus, philosopher, philanthropist, financial expert and churchman, was born at Thorn, Poland, February 19, 1473. Under the patronage of his uncle, a bishop, he received the most thorough education of the period, studying mathematics three years at the University of Cracow, canon law and astronomy under Novara at Bologna, lecturing himself in Rome in the year 1500, taking up medical studies at Padua for four years, 1501-1505, and also receiving the degree of doctor in canon law at Ferrara May 31, 1503. He was his uncle's private physician until the death of the latter in 1512, received the post of Canon of Frauenberg, and exerted himself for many years as physician to the poor.

Copernicus laid the main lines of his famous theory of celestial orbits about the year 1513, but published nothing for many years, though endeavoring to test his views with the scanty instruments at his command. His great treatise, "De revolutionibus orbium cœlestium," was finished in 1530 but not published until 1543. It, however, had attracted so much attention while yet in manuscript that lectures were given upon it in Rome much earlier, and the theory received the general approval of the Pope and hierarchy. The first copy of the great work reached Copernicus on his deathbed in 1543, but he was already so low that he probably never appreciated that the book was marred by a preface by Osiander in which he attempted to disarm prejudice by insisting on the purely speculative character of the work.

Copernicus also published a large work on monetary reform.

The Ptolemaic theory which was then in vogue regarded the earth as stationary and accounted for the apparent motions of the planets by a complex system of epicycles. Copernicus, following the suggestion of Professor Novara at Bologna, adopted the view that the sun is the stationary center of the solar system and that the stars are also stationary. He failed to introduce the hypothesis of elliptical orbits for the great planets, including the earth, so that he had still to retain a number of epicycles of Ptolemy

If, as Copernicus urged, the earth revolves about the sun, the stars ought to show parallactic evidences of this motion just as a forest of trees indicates by the apparent march of the nearer stems with the respect to the farther ones the motion of the observer. The absence of any sensible stellar parallax was for three hundred years the difficulty in the way of Copernicus' theory. Furthermore, to many of the schoolmen the idea of a mobile earth seemed blasphemous.

The defects of Copernicus' theory began to be removed by the careful observations of Tycho Brahe at the observatory at Cassel, erected for him by the Landgrave of Hesse-Cassel. Kepler, the follower of Tycho Brahe, making use of these excellent observations, was able to discover his three famous laws: (1) That planets travel in ellipses with the sun in one focus. (2) That equal areas are described by the radii vectores in equal times. (3) That the squares of the periods of revolution are proportional to the cubes of the mean distances.

Sir Isaac Newton put the capstone on this edifice by his mathematical proof that these three laws of Kepler are all consequences of the hypothesis of an attracting force of gravitation varying proportionately to the product of the masses, and inversely to the squares of the distances separating them.

The final difficulty of the Copernican theory was removed in 1838 by the nearly simultaneous measurement of Bessel and Henderson of the parallaxes of the stars 61 Cygni and of α Centauri.

At this time of the four hundred and fiftieth anniversary of the birth of Copernicus, it is well to reflect upon the momentous consequences of the release of the human mind from the bonds of blind obedience to preconceived notions, partly religious and partly superstitious, which had made the speculations of the schoolmen so fruitless and had made life and property so insecure from the inquisition of those who felt themselves responsible for the destruction of heresy. Copernicus has left us a model of the earnest, kindly, modest student of science, content to test and verify before publication, but withal concerning himself with the profoundest problems of his time.

The Smithsonian Institution will hold an informal meeting at 4 o'clock, February 19, for its employees and others who may care to attend, at which a brief address will be made by the assistant secretary, Dr. Abbot, on Copernicus and his astronomical theory. The institution regards it as very appropriate that similar meetings should be held at that time at other seats of learning.

C. G. ABBOT

SMITHSONIAN INSTITUTION

SCIENTIFIC EVENTS

EDWARD JENNER[1]

IT is a hundred years since the remains of Edward Jenner were laid to rest in a vault in the chancel of Berkeley Church. He died on January 26, 1823, and was buried on February 3. He had been born in 1749 in the vicarage of Berkeley, and spent a large part of his professional life in his native village as a general practitioner—one of the most illustrious who has ever adorned the ranks of medicine. His great teacher and friend, John Hunter, wanted him to enter on a different career; but Jenner was a born naturalist, fond of a country life, so that even when, in the interests of vaccination, he was persuaded to take a house in London, he quickly repented, and later on returned to Berkeley.

The oft-told story of his great conception of preventing small-pox by means of cow-pox is classical in its simplicity and brevity. In his master's surgery at Sodbury he heard a countrywoman remark that she could not take small-pox because she had already had cow-pox. The little incident remained in the mind of the busy village doctor for many years, to be mused over, discussed with friends lay and medical, set aside and returned to with a curious mixture of perseverance and dilatoriness which was no doubt in his mind when he remarked in his *Inquiry* that people may not be aware "how often men engaged in professional pursuits are liable to interruptions which disappoint them almost at the instant of their being accomplished. Ultimately, however, in 1796, he put the matter to the touch—he inoculated with cow-pox, tested the effect by inoculation with small-pox, and found that immunity had been achieved. The rest of his life was devoted mainly to the promotion of vaccination. . . .

The centenary of Jenner's death follows close on that of Pasteur's birth. Their lives overlapped by a month, Pasteur having been born thirty days before Jenner died. Their life's labors were closely related. Apart from variolation with its serious disadvantages, vaccination was the first example of the operation of the principle of individual immunization. For the greater part of a century it remained an oasis in a desert, and for long there seemed no prospect of its further application. Now, however, since Pasteur brought into existence the science of bacteriology, the sphere of immunization by different methods has been wonderfully extended, and the armamentarium of preventive medicine correspondingly strengthened. In a remarkable passage in one of his books Sir John Simon wrote that "if departed great benefactors of our race could now and then look down on the harvest fields where mankind age after age is gladdened by the fruits of their labor, they would in general find themselves less remembered than perhaps their terrestrial ambitions had desired"; but, he adds, "let the noble compensation be noted that often the thoroughness of a reformer's victory is that which most makes silence of the reformer's fame. For how can men be adequately thankful for redemptions, when they have no present easy standard, no contrast between yesterday and to-day by which to measure the greatness of them?" That question applies specially to the case of Jenner, but neither Jenner nor Pasteur can ever be forgotten. It was, if we recollect aright, in an address at the centenary of the death of Robert Burns that Lord Rosebery, speculating about the duration of personal fame, prophesied that if there were every hundred years a roll call of the famous departed, the "Adsum" of Burns would sound clear and strong all down the coming time. In the much more prosaic sphere of preventive medicine and the benefactions of science, so it will be with Edward Jenner and Louis Pasteur.

THE LONDON ZOOLOGICAL GARDENS[1]

IN consequence of the retirement on pension of Mr. R. I. Pocock, F.R.S., who attains the age of sixty in March after having been superintendent of the Zoological Gardens and curator of mammals since 1904, the council has rearranged the staff at the gardens. Dr. G. M. Vevers, at present a Beit Research Fellow and on the staff of the London School of Tropical Medicine, has been appointed superintendent, and, under the direction of the secretary, will be the principal officer there. Mr. D. Seth Smith, at present curator of birds and inspector of works, has been promoted to be curator of mammals and birds with a residence in the gardens. Mr. E. G. Boulenger retains his curatorship of the reptiles, but will also be in charge of the new aquarium. Miss Cheesman remains curator of insects, Dr. Sonntag, anatomist, and Dr. Lucas, pathologist, are also to be in charge of the sanatorium (which is being re-equipped), in consultation with Professor Wooldridge, honorary veterinary surgeon to the society, and the superintendent and curators. A panel of experts under the honorary direction of Professor Leiper, of the London School of Tropical Medicine, has undertaken the collection and examination of the parasites. Dr. R. W. A. Salmons, M.D., F.Z.S., honorary radiologist at University College Hospital, has been appointed honorary radiologist to the society.

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[1] *The British Medical Journal.*

[1] From the *London Times.*

Mr. R. I. Pocock, the retiring superintendent, was formerly on the staff of the British Museum (Natural History), an appointment which he resigned in 1904 when he went to the gardens. His chief zoological work until 1904 was on arachnids and myriapods, on which difficult groups he was a recognized authority. Since 1904 he has devoted himself chiefly to mammals, and he has published a large number of memoirs in technical scientific journals on the classification of many groups and especially on the bearing of external characters on the systematic position of mammals. For many years he has been a regular contributor to the *Field*, on the staff of which he remains, and he is the author of a number of papers on natural history. He is a vice-president of the Linnean Society and was elected to the Royal Society in 1911. His knowledge of the species and varieties of mammals is very great, and he was able to identify any mammal brought to the gardens, however rare, almost at a glance and to say whether it was new to the collection.

Dr. Vevers is thirty-three years old. When the war broke out he was in his fifth year as a medical student at St. Thomas's Hospital, but joined the army at once. In 1915 he was sent back from France with other former medical students in their fourth and fifth years and, after qualifying, was given a commission in the R. A. M. C., and served in France until the middle of 1918, when he was sent home for duty in this country. On being demobilized in 1919 he engaged in private practice for a few months and was then appointed to the London School of Tropical Research. Soon afterwards he gained a Beit Memorial Research Fellowship for work in parasitology. He was honorary parasitologist to the society for two years and already has a good knowledge of the gardens. In 1921 he was sent on a scientific mission to British Guiana, where he was able to make some collecting expeditions into the bush. He has undertaken to devote his scientific work in future to the problems relating to animals, including their psychology, which can be better studied in a collection of living animals than in a museum or laboratory.

LIST OF SCIENTIFIC PERIODICALS

AT a meeting of the Conjoint Board of Scientific Societies held at the Royal Society on January 24 a definite constitution was given to a scheme to prepare and issue a list of all scientific periodicals containing the results of original research, with an indication of the chief libraries in Great Britain where they may be consulted.

As has already been reported in SCIENCE, an influential committee representing different branches of science has been arranging for the preparation and publication of a complete list. The trustees of the British Museum, recognizing the importance of the work to scientific research and bibliography, consented to allow the preparation of the list to be undertaken by the staff of the keeper of printed books. Material has been sent in by many scientific societies and libraries, and there is good hope that the list will be published before the end of the year. As the result of a preliminary circular, between three and four hundred copies have already been subscribed for at £2 each. The Carnegie United Kingdom Trust have guaranteed the cost of publication up to £1,000 on condition that libraries at a larger number of centers in Great Britain than was originally intended should be included. Sir Robert Hadfield and Mr. Robert Mond have each given a further guarantee of £250.

The Conjoint Board, after having heard the satisfactory progress already made, agreed to vest the World List in three permanent trustees—Sir Arthur Schuster, F.R.S., Mr. Robert Mond and Dr. Chalmers Mitchell, F.R.S.—the trustees to have complete financial control.

but to be advised on the general conduct of the scheme by the existing committee.

CORNELL UNIVERSITY SUMMER SCHOOL OF BIOLOGY

A summer school of biology will be established at Cornell University this year. It will be conducted under the joint auspices of the university's regular summer session and the New York State College of Agriculture. Intensive courses of study designed particularly for teachers and graduate students will be given during the six weeks' summer session from July 7 to August 17, and facilities will be provided for research throughout the summer.

This will be a fresh-water school of biology, as distinguished from several coastwise summer schools in which marine forms of plant and animal life are necessarily the principal objects of study and demonstration. Teachers and investigators in the interior states have felt the need of a summer school where the materials for the study of biology are the same as those which they find available for use in their own class rooms and laboratories. The neighborhood of Cornell University is said to have an extraordinary wealth of such materials in both plants and animals. Within easy reach of the laboratories are fresh-water lakes and marshes, salt springs, marl springs, marl bogs, peat bogs, extensive and deep ravines with numerous waterfalls and upland woods and fields overlying either sandy or heavy soils. Some of these soils are impregnated with lime and some are not. Within a radius of two miles of the Cornell campus there is a variation of more than a thousand feet in altitude, so that the plants and animals in this small area belong to several different life zones.

Biology has been studied intensively at Cornell ever since the time of Louis Agassiz, who was a teacher there fifty-five years ago. One result of this sustained interest has been to assemble there a wealth of laboratory material, including some unique collections of plant and animal specimens, and a complete working library, all of which will be available for those students who are prepared to use them.

As far as possible the staff of the school will be composed of professors who are members of the regular faculty of the university. The teachers will include Professors O. F. Curtis, A. J. Eames, H. M. Fitzpatrick, A. C. Fraser, W. C. Muenscher, H. H. Whetzel and Karl M. Wiegand in botany, plant pathology and plant breeding; Professors J. C. Bradley, O. A. Johannsen and Robert Matheson in entomology; Dr. B. F. Kingsbury in animal histology and embryology; Dr. W. A. Hagan in pathology and bacteriology, and Professors Hugh D. Reed and Albert H. Wright in zoology.

THE MEDALS OF THE AMERICAN GEOGRAPHICAL SOCIETY

The American Geographical Society announces the award of the Charles P. Daly Medal for 1922 to two recipients: Major General Adolphus Washington Greely and Ernest de Koven Leffingwell. The Cullum Geographical Medal for 1922 has been awarded to Edward A. Reeves, map curator of the Royal Geographical Society, London, and director of the School of Surveying. The inscriptions upon the medals themselves briefly indicate the reasons for the award in each case. They are as follows:

Adolphus Washington Greely
1922

He commanded an Arctic expedition the results of which are among the imperishable records of polar discovery; and he subsequently rendered distinguished public service as chief of the United States Signal Corps.

Ernest de K. Leffingwell
1922

For producing the first accurate chart of a part of the Arctic coast of Alaska and for sustained and original investigations in Arctic physiography.

Edward A. Reeves
1922

In honor of his substantial achievements in geographical surveying. By devising and improving instruments and methods he created new standards in the field of scientific exploration.

SCIENTIFIC NOTES AND NEWS

Dr. Edward E. Barnard, professor of astronomy in the University of Chicago and astronomer of the Yerkes Observatory, died on February 7 at his home at Williams Bay, aged sixty-five years.

BERNHARD EDUARD FERNOW, first chief forester of the United States, died at Toronto on February 6, aged seventy-three years. In 1898 he became dean of the School of Forestry at Cornell University. After the closing of the school by the legislature in 1907, he became dean of the faculty of forestry at the University of Toronto, retiring as professor emeritus in 1919.

WILHELM KONRAD ROENTGEN, professor of physics in the University of Munich, who obtained in 1895 a world-wide reputation by the discovery of the X-rays, has died in Munich at the age of seventy-seven years.

DR. JOHANNES ORTH, the distinguished pathologist, and successor of Virchow at the Berlin Pathological Institute, died on February 13 within a few hours of his seventy-sixth birthday.

PROFESSOR A. A. MICHELSON, of the University of Chicago, was awarded the gold medal of the Royal Astronomical Society for the "application of the interferometer to astronomical measurements," at the annual meeting of the society in Burlington House, London. Professor Michelson, being unable to attend personally, was represented by Post Wheeler, chancellor of the American embassy.

DR. J. PAUL GOODE, of the University of Chicago, was presented with the Helen Culver gold medal at a meeting of the Geographic Society of Chicago on January 26.

PROFESSOR DOUGLAS W. JOHNSON, of Columbia University, has been elected a foreign member of the Swedish Society for Anthropology and Geography.

PHYSICIANS, graduates of Northwestern University and students under Dr. Winfield Scott Hall, professor of physiology at Northwestern University School of Medicine, Chicago, gave a dinner in his honor at the Plaza Hotel, Danville, on January 17.

DR. T. WAYLAND VAUGHAN has been elected president of the Washington Academy of Sciences.

HENRY SOLON GRAVES, dean of the forestry school of Yale University, was elected president of the American Forestry Association at its meeting in Boston.

DR. A. S. HITCHCOCK, of the Bureau of Plant Industry, has been elected president of the Biological Society of Washington for 1923.

THE following officers of the State College, Pennsylvania, Branch of the American Association for the Advancement of Science have been elected for 1923: *Chairman,* C. R. Orton; *vice-chairman,* R. D. Anthony; *treasurer,* J. E. DeCamp; on the *executive committee,* Miss Edith P. Chace and D. C. McFarland. The tenure of office of secretary is for four years and the present term does not expire until 1924. The other offices are filled each year.

PROFESSOR W. P. WYNNE has been nominated to fill the office of president of the Chemical Society, London, which will be vacated by Sir James Walker.

DR. W. H. ECCLES, professor of electrical engineering at the City and Guilds of London Technical School, and vice-chairman of the Wireless Telegraphy Commission, who succeeds Admiral of the Fleet Sir Henry Jackson as president of the Radio Society of Great Britain, delivered his presidential address to the society at the Institution of Electrical Engineers on January 24.

PROFESSOR FILIBERT ROTH, head of the department of forestry of the University of Michigan, whose resignation from the faculty has been accepted with regret by the regents, will remain with the university until the close of the present academic year.

PROFESSOR WILLIAM NIKOLAI BOLDYREFF has taken a position at the Battle Creek Sanitarium, where he will conduct research along lines similar to those followed by him with Pawlow in Petrograd. Professor Boldyreff was an assistant to Pawlow from 1902 to 1912. From 1912 to 1917 he was professor of pharmacology in Kazan, Russia.

DR. J. C. MCLENNAN, professor of physics at the University of Toronto, has been granted a leave of absence for the remainder of the school year. He will visit important laboratories of Great Britain, France and Holland, returning in September in time for the meeting of the British Association for the Advancement of Science, which meets this year at the University of Toronto.

DR. WILLIAM WALTER CORT, associate professor of helminthology in the Johns Hopkins School of Hygiene and Public Health, has been appointed exchange professor in parasitology in the Peking Union Medical College for the academic year beginning October, 1923. Professor Cort will also study hookworm disease in South China. Dr. Ernest C. Faust, associate professor of parasitology at the Union Medical College, will exchange professorships with Dr. Cort.

DR. BÉLA SCHICK, professor of pediatrics at the University of Vienna, gave the Cutter lecture on preventive medicine at Harvard University on February 8. His subject was "The prevention and control of diphtheria."

THE seventh Harvey Society lecture to be given at the New York Academy of Medicine on Saturday evening, February 24, 1923, will be delivered by Dr. Leon Asher, professor of physiology in the University of Berne. His subject will be "The building up of the organism by chemical and nervous coordination and regulation." The lecture by Dr. E. V. Cowdry, of the Rockefeller Institute for Medical Research, on "The significance of the internal reticular apparatus of golgi in cellular physiology," has been postponed until Saturday evening, March 10.

PROFESSOR SOMMERFELD will give the following course of lectures at the Bureau of Standards from March 2 to 9: "Introduction to quantum theory and its place in modern physics," March 2; "Quantum theory of spectroscopy, Balmer spectrum of H, etc.," March 3; "Atomic structure of the chemical elements," March 5; "Wave theory and quantum theory," March 6; "The significance of quantum numbers, azimuthal, radial, equatorial, inner, etc.," March 7; "Zeeman effect, theory of magneton," March 8; "Line structure in complicated spectra," March 9.

PROFESSOR R. A. EMERSON, head of the department of plant breeding at Cornell University, lectured before the Ohio chapter of the Sigma Xi Society on January 31 on "The mechanism of organic heredity."

DR. EVARTS A. GRAHAM, professor of surgery in the Washington University School of Medicine, has accepted an invitation from the California Academy of Medicine to speak on the "New phases of thoracic surgery." He held a clinic at the Leland Stanford University on February 9 on thoracic surgery, and a clinic on gall bladder surgery at the University of California on February 10.

DR. E. F. PHILLIPS, of the U. S. Bureau of Entomology, gave an address on "Research in bee-keeping with practical applications," before a joint meeting of the Purdue Chapter of Sigma Xi and the Purdue Biological Society at Lafayette on February 1.

DR. E. H. STARLING will deliver the Harveian lecture of the Royal College of Physicians, Dr. J. H. Abram, of Liverpool, the Bradshaw lecture, and Lieutenant Colonel William Glen Liston, C.I.E., the Milroy lectures in 1924. The Milroy lectures for this year will be delivered by Dr. W. G. Savage, on "Canned foods in relation to health," on February 22 and 27 and March 1; the Goulstonian lectures, by Dr. Geoffrey Evans, on "The nature of arteriosclerosis," on March 6, 8 and 13, and the Lumleian lectures, by Dr. Arthur J. Hall, on March 15, 20 and 22, on "Encephalitis lethargica."

A COMMITTEE has been formed to establish a memorial to Benjamin Harrison, the village geologist and prehistoric archeologist of Ightham, Kent, England, who died in 1921. The first meeting of the committee was held at the Royal Anthropological Institute in November, 1922, under the presidency of Lord Avebury. Donations will be received by the treasurer, Mr. de Barri Crawshay, Rosefield, Sevenoaks (Kent).

THE Wellcome Historical Medical Museum, London, has arranged a special exhibition of personal relics, pictures, engravings, drawings, documents, manuscripts and letters relating to the discovery of vaccination, in connection with the commemoration, on January 26, of the centenary of the death of Dr. Edward Jenner. The exhibition will be open for some months.

THE centennial of the birth of the surgeon, Friedrich von Esmarch, who died at Kiel in 1908, occurred on January 9, 1923.

ROBERT MORAN, Puget Sound shipbuilder, has given to the University of Washington a $12,000 towing boat, the *Rosario,* to be used at the university's Puget Sound biological station, at Friday Harbor, Washington, in dredging for deep-sea biological specimens. This is the third offer which Mr. Moran has made to the university. In donating a park at Mount Constitution to the state of Washington, he expressly reserved the right of the university to make use of this tract for scientific and educational purposes. Later when the university was seeking to find a larger and more effective property for its biological station, he offered the regents, as a gift, the valuable property known as Obstruction Island. Meanwhile, the government had given to the university the Point Caution military reservation of four hundred and eighty-five acres, which was more favorable from a scientific standpoint.

Dr. Lee de Forest, the inventor of the "audion" and other improvements in radio apparatus, has established a fund for the purchase for Yale University of a library devoted to radio matters, which will be of service to those engaged in study and research in this field. He has also established a fund to provide for a course of twelve lectures to be given each year for the benefit of advanced students and members of the staff. It will be possible, with the aid of this fund, to invite to Yale University each year a number of leading experts to supplement the work of the regular courses offered by the university. For the present year, beginning in February, the lectures will be given by the following men: George A. Campbell, American Telephone and Telegraph Company; Lloyd Espenscheid, American Telephone and Telegraph Company; Commander S. C. Hooper, United States Navy; Dr. Albert W. Hull, General Electric Company; Professor John Morecroft, Columbia University, and L. E. Whittemore, Bureau of Standards. Dr. de Forest will speak on "Wireless" at the eighth annual meeting of the Yale Engineering Association, which will be held at the New York Yale Club on February 1. Apparatus will be installed and a demonstration given.

The New York State Museum is again offering to the public a course of lectures on subjects of general and public interest. They are given in the rooms of the museum in the State Education Building on Friday afternoons at 4 o'clock. The schedule of lectures is as follows: January 12, "A naturalist in the Adirondacks," by Homer D. House, state botanist; January 19, "Indian medicine and medicine men," by Arthur C. Parker, state archeologist; January 26, "Origin and evolution of the insects," by Ephraim P. Felt, state entomologist; February 2, "Are we still living in the glacial period?" by John H. Clarke, state geologist; February 9, "Where are we from?" by John M. Clarke; February 16, "What the salamanders do," by Sherman C. Bishop, state zoologist; February 23, "The story of petroleum in New York," by C. A. Hartnagel, assistant state geologist; March 2, "Insects and wireless," by Ephraim P. Felt; March 9, "The great Devonian forest," by Winifred Goldring, state paleobotanist; March 16, "Mastodons and mammoths," by Sherman C. Bishop; March 23, "The background of New York history," by John M. Clarke; March 30, "Wild flowers and their protection," by Homer D. House.

One hundred thousand dollars of the $200,000 legacy left to Harvard by the late Hiram F. Mills, of Quincy, to establish the Elizabeth Worcester Mills fund with its income devoted to the investigation of the origin and cure of cancer, has been received. This income will aid the work of the Harvard Cancer Commission which is carrying on extensive research in the new John Collins Warren Laboratory adjoining the Huntington Memorial Hospital. It is expected that the bequest will make possible a much more detailed investigation of the constitutional effects of radium and especially of the high-powered X-ray machine designed by Professor William Duane and installed in the new laboratory for the treatment of cancer cases.

Dr. G. J. Esselen, Jr., chairman, cellulose division, American Chemical Society, writes that Dr. C. J. West, chairman of the committee on bibliographies of the Technical Association of the Pulp and Paper Industry, has kindly offered to act for the Cellulose Division of the American Chemical Society as a receiving center for bibliographies relating to any branch of cellulose chemistry. It is hoped that all of those having such bibliographies will send a copy to Dr. West, the National Research Council, 1701 Massachusetts Avenue, N. W., Washington, D. C. Dr. West has kindly offered to assemble all material received and make it available to any one interested. It is hoped that a large amount of duplication of effort can be avoided in this way.

UNIVERSITY AND EDUCATIONAL NOTES

THE will of the late John McMullen, of Norwalk, Conn., and New York, was upheld by a jury in the Superior Court on February 7. A compromise was reached, but no details were given out. Under the will the bulk of the $2,000,000 estate goes to Cornell University.

MR. DAN RADCLIFFE, the shipowner, of Cardiff, has promised to give £50,000 in 3½ per cents. for the benefit of the University of Wales in honor of the Prince of Wales.

DR. THOMAS STOCKHAM BAKER, formerly professor of German in the Johns Hopkins University and director of the Jacob Tome Institute, has been elected president of the Carnegie Institute of Technology, where he has been since 1919 secretary of the institute and acting president since the resignation a year ago of Dr. A. A. Hamerschlag.

DR. OTTO M. SMITH, formerly in charge of research for the Roseville Chemical Company, Roseville, Indiana, has been appointed assistant professor in quantitative chemistry at Iowa State College.

PROFESSOR F. TRENDELENBURG, of Tübingen, has refused a call to the University of Berlin to serve as the successor of Rubner for the chair of physiology. A call has been sent to Dr. Franz Hofmann, of Bonn.

PROFESSOR H. POLL, of the University of Berlin, has been appointed professor of general biology and the theory of heredity.

DR. POTTEVAN, senator, has been elected professor of general hygiene in its relations to industry in the Paris Conservatoire National des Arts et Métiers.

DISCUSSION AND CORRESPONDENCE

REACTION TIME AND FATIGUE

THE personal equation in star transits is due to the coordination of eye, hand and brain of the observer. Its absolute amount is difficult to determine, as artificial transits must always lack some features of the usual observing conditions. Fortunately it does not affect most of our right ascension results, since they are derived from the differences of transits, in which the effect is eliminated, if it is constant. In longitude campaigns, also, the difference of personal equations can be eliminated by exchanging stations.

We can not determine absolute clock corrections, nor absolute clock rates without taking account of personal equation and its constancy. For the mean daily rate of a clock, derived from successive observations of the same stars, the equation eliminates, if it is constant. For hourly rates, derived from successive clock corrections during a night, the question of variability of personal equation needs consideration. Variation might be produced by fatigue or other physical conditions.

There are traditional stories in astronomical practice of observers who indulged in the excessive use of strong stimulants, such as coffee, in excessive smoking and, possibly, taking into account the origin of these stories, in *Pilsener* for the contrary reflex, and then proceeded to determine the effects upon observations. Large accidental variations would be anticipated, rather than systematic changes, with such abnormal deviations from the habits of rational observing.

In the series of observations recently completed here for the purpose of testing a possible diurnal periodic term in clock performance, the test of change in personal equation emerges as a by-product. The test is a delicate one, and it is only by assembling a relatively large mass of material that a reliable conclusion can be reached.

Six hours of continuous observing have been included on each of twenty-four nights during a complete year, nearly two thousand transits in all. For the usual night of about four hours' interval no sensible amount of physical or mental fatigue is commonly experienced. Perhaps it is the consequence of more than forty years of observing that renders an observer sensitive to real fatigue at the close of six hours of work. Ordinarily it would not be considered wise to continue work when the precision of the results might be affected by physical conditions, but the requirements of this special problem made it advisable to use these long periods.

In the closing error of a cycle of observed clock rates, where each pair of successive hours of right ascension has been employed, with invariably the same stars in each hour, there are four conditions to consider, as influencing the results.

The errors of the adopted right ascensions enter every computed hourly rate, but these errors are completely eliminated in summing up the cycle.

Progressive change in instrumental corrections would produce progressive changes in computed clock rates, if undetected, and the performance of the meridian instrument has consequently received careful and rigorous treatment in this special series.

The difference between clock corrections observed at sunset and sunrise may be due to special conditions affecting the observed results at these two epochs of the day, or to a diurnal variation in the clock rate.

Progressive change in personal equation during the night would produce a computed change of observed clock rates.

The closing error of this series will be assumed to be due to either one or both of the last two conditions enumerated.

The summation of the observed clock rates gives the following means for successive pairs of hours from 9 P. M. to 3 A. M. The means are the excesses of observed hourly rates over the average daily rates of the clock at the corresponding epochs.

	s.
First two hours, excess	—0.002
Second two hours, excess	—0.003
Third two hours, excess	+0.005
Fourth two hours, excess	+0.005
Fifth two hours, excess	—0.000
Mean	+0.001
Average	±0.003

The probable error of observation for a rate from two successive hours, as summed up, is $\pm 0.^{s}002$. The deviations from the mean of all are evidently fortuitous and there is no real progressive change such as would be due to the effect of fatigue or to periodic variation of the clock rate, unless these two effects balance each other.

The constancy of the reaction time, assuming uniform performance of the clock, should interest psychologists and physiologists, and the measure of its variations within errors of less than one one-hundredth of a second can be confirmed by other observers.

R. H. Tucker

Lick Observatory

PHYSIOLOGY OF STOMATA OF RUMEX PATIENTIA

The behavior of the stomata of *Rumex patientia* has been studied for the past two years and, although the work has not been completed, the data at hand are sufficient to warrant the following conclusions:

1. The stomata close completely at night and check water loss from the intercellular spaces of the leaf.

2. When open the stomata modify the rate of water loss from the intercellular spaces of the leaf in proportion to changes in their perimeters, not to changes in their areas.

3. Light is the most important environmental factor, while acidity and the amount of water in the guard cells are the two internal conditions directly concerned with stomatal movements.

4. The guard cells contain green plastids which are structurally, physiologically and genetically different from the chloroplasts of the mesophyll.

5. The starch-sugar change in the guard cells is an equilibrium reaction and the point of equilibrium is shifted by changes in acidity. The guard cells change in acidity more readily than the mesophyll cells because their buffer content is low.

6. The series of changes which result in the opening of the stomata is as follows:

(*a*) In the morning the light changes the acidity of the guard cells.

(*b*) This change in acidity makes conditions more favorable for the hydrolytic action of diastase.

(*c*) The diastase in the guard cells changes the starch to sugar.

(*d*) The formation of sugar results in an increase in the osmotic pressure of the guard cells.

(*e*) Water enters the guard cells from the epidermal cells which do not change in pressure and causes them to swell.

(*f*) The swelling of the guard cells causes them to open because the thickened cell wall around the pore stretches less than the thinner parts of the cell wall.

This series of changes does not take place if the leaves are wilted. If wilting occurs after the guard cells are open the point of equilibrium is shifted so that the sugar changes to starch and the guard cells close. If the leaves remain turgid the guard cells remain open until darkness and close by a reversal of this series of changes. These changes can be made to go in either direction by experimentally changing the acidity of the guard cells.

J. D. Sayre

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A BOTANICAL SPELLING MATCH

"Can one imagine a botanical or an entomological spelling match?" "Could 'aster' or 'grasshopper' be drawn in recognizable detail by the contestants?" These are two of the questions asked by Dr. C. E. Waters in Science for November 24.

The writer can not answer for entomology but he can for systematic botany. Formulæ may be used to express the structure of flowers. For example, the flower formula of the Boraginaceæ can be written $\mathrm{Ca}^{\textcircled{5}}\ \overset{\underline{\mathrm{S}^{5}}}{\mathrm{Co}}{}^{\textcircled{5}}\ \mathrm{P}^{\textcircled{4}}$, of the Liliaceæ $\mathrm{Ca}^{3}\ \mathrm{Co}^{3}\ \mathrm{S}^{6}\ \mathrm{P}\textcircled{3}$. In this way formulæ may be written for families, genera and species. The flower formula expresses concisely the following features: number of parts in the flower, kinds of parts, arrangement of parts, something of the shape of the flower and the position of the flower in evolution. On hearing or reading such a formula the structure and shape, as well as the taxonomic position, of the flower are immediately brought to mind. Surely it would not be difficult to imagine a spelling match in a class in systematic botany!

Herbert C. Hanson

Department of Biology,
University of Arizona

SCIENTIFIC BOOKS

A GUIDE BOOK OF THE GEOLOGICAL SURVEY

The fifth volume of the series of guide books of the western United States which our national geological survey has been producing in the last seven years is as attractive as its predecessors.

It deals with that portion of Colorado and Utah which is served by the Denver and Rio Grande Western Railway, a region visited by more tourists than any other portion of the country west of the Mississippi. To them this book would be a boon if it could be brought to their notice. Being an official publication bound in a grey paper cover it is not apt to be as widely known as it would be were it published by an enterprising publishing house, bound in bright red cover, placed in all the book stores, and mentioned in many magazines and circulars. But it is worthy of wide publicity because of its excellence. Campbell has beaten Baedeker at his own game. The book is charmingly written, beautifully illustrated and furnished with excellent maps.

The main part of the text presents in clear manner the succession of events which have resulted in the present Colorado and Utah. It does not go back just a few months or years, but begins far enough back to include the whole history of the region from earliest archæan times till 1922 A. D.

The foot notes in fine print contain the side lights on the main circuit. They deal with economic statistics, histories of individuals, explanations, definitions and illustrations of the main theme and are hardly less interesting or important than the main theme.

The central topic—the present constitution, structure and topography of the country and the forces which have produced them—is presented in a clear manner as entertaining as the talk of a clever man at a club. University students in that part of the country will no doubt use the volume as a text book since it may be obtained of the United States superintendent of documents for one fourth the price necessarily charged for the average geology, and since it is so practical and interesting. The average geological text book has the disadvantage of jerking the mind from one part of the world to the other for illustrations. This book illustrates point after point right on the spot. In the regions treated the reader can see nearly every principle of the earth's history strikingly set forth.

To apply geology to a definite locality is an excellent practice. It tends to take the science out of the realm of theory and place it in that of reality and give it "a local habitation and a name."

Fortunate is the man who in spite of other pressing duties, finds time to read this book through and in this manner adds to the pleasure of former or coming trips in this region.

If further editions are brought out it would be well to name the formations shown in pictures and sections. For example in Plate XXI is Lyons sandstone of the Pennsylvania System seen at the gateway of the Garden of the Gods. In Figure 10, p. 37, why should "N" indicate Morrison, "B" Fox Hill, "T" Pennsylvanian, etc.? Why use one series of signs to indicate another series? Why not write down directly the name of the formation indicated and so all through this and the majority of works on geology? This old custom of using one sign to represent another sign is the geologist's way of whipping the devil around the stump. The direct action plan will help to drive away ignorance in geological matters.

A sketch map of Corona and the Denver and Salt Lake Railroad might well replace one of the two illustrations of Castle Rock (p. 21 and 26).

The present writer may be excused in inquiring why the state museum was not mentioned on p. 6.

Suggestions such as the above are mere incidents. As a whole the book is delightful and valuable and people who discover it will be indeed fortunate.

A. R. CROOK.

STATE MUSEUM,
SPRINGFIELD, ILLINOIS

SUGGESTIONS FOR A WORLD-CODE OF PLANT NOMENCLATURE

THE trend of a recent discussion in *The Journal of Botany* (London, 1921, 153, 289; 1922, 111, 129, 199, 256, 313) suggests that the time is ripe for an attempt to secure world-wide agreement on plant-nomenclature. It has been shown that the divergence between the Type-basis Code and the International Rules leads to dual nomenclature in one out of every nine species of Phanerogams, apart from any differences in generic concept (op. cit. 1922, 129-131). Few will deny that such a state of affairs seriously handicaps the progress of systematic botany, since it necessarily results in much time, which might otherwise have been devoted to taxonomic work, being occupied with questions of nomenclature.

Is it not possible to combine the best features of both codes? An excellent summary of the chief differences between them has been given by Mr. A. S. Hitchcock (op. cit. 1922, 316). These concern (1) the type-concept; (2) the starting-point or points of nomenclature for certain groups of non-vascular plants; (3) nomina conservata; (4) publication of genera; (5) priority of position; (6) validity of homonyms; (7) duplicate binomials; (8) Latin diagnosis.

To deal with the less controversial points first: No. 7 is surely of little moment. Personally, after considering the arguments for and against, I am now in favor of accepting duplicate binomials, on the ground that the advantage of preserving the earliest specific name outweighs all other considerations. Duplicate binomials are less open to objection than many names which are treated as valid under the International Rules. No. 2 is a matter for the cryptogamists concerned: if they can arrive at an agreement, so much the better; but, if not, why should this stand in the way of agreement on other points? As to No. 8, many Internationalists now consider that Art. 36, which made a Latin diagnosis obligatory, should be revoked.

In regard to No. 4, publication of genera, the Rules treat a generic diagnosis (or reference to a former diagnosis of the group) as obligatory: otherwise it would be open to any name-monger to establish an unlimited number of new genera, without the slightest indication of their generic characters, by merely mentioning the names of species included in them. Surely no group should be recognized unless its diagnostic characters have been given. On the other hand, the Code requires that a generic name should be associable with a binomial specific name, this being essential under the type-system. Are not both requirements reasonable? For the complete definition of a genus, both its diagnostic characters and the species included in it should be stated.

There remain for consideration (1), the type-concept; (3) nomina conservata; (5)

priority of position; and (6) validity of homonyms. These questions are closely connected.

As has been pointed out, the type-concept is not contrary to the International Rules. One obstacle to its adoption by Internationalists, however, is the rigid manner in which it has been applied. Provided that wholesale changes in generic nomenclature are avoided by the recognition of "substitute types," as suggested by Mr. Hitchcock, there seems no reason why the type-concept should not be explicitly incorporated in the International Rules.

The chief difficulties are connected with "nomina conservata" and homonyms. It seems certain that "nomina conservata" will retain a place in any International Rules of the future. But the present list admittedly contains some generic names which should not have been included. And the Type-basis Code recognizes that the strict application of the law of priority may cause inconvenience by displacing well-known names, and provides for exceptions through Art. 6. Hence there is no difference of principle involved, and it is merely a question of deciding what names should be included in the list. This task might be entrusted to a joint committee, as suggested by Mr. Hitchcock (op. cit. 1922, 318). Among names which might be deleted from the list are cases of wrong application of generic names such as *Allionia* Linn. emend. Choisy (op. cit. 1922, 314) and those of unimportant genera with few species.

The present provisions of the International Rules in regard to homonyms are admittedly unsatisfactory, as they make the validity of a homonym dependent on the non-validity of the first use of the name, which may be a matter of opinion (op. cit. 1922, 133). Under the Type-basis Code, on the other hand, many well-known generic names are replaced on the ground of their being homonyms, which is equally unsatisfactory. It is therefore suggested (1), that all specific homonyms should be treated as non-valid; (2) that such well-known generic names as are homonyms should in the discretion of the proposed committee be placed on the list of nomina conservata; (3) that all other generic homonyms should be treated as non-valid.

Priority of position is an extreme extension of the principle of priority and might well be abandoned in the interests of general agreement. My suggestions for harmonizing the International Rules and the Type-basis Code may now be summarized as follows:

1. Acceptance of the type-concept, with provision for the recognition of "substitute types."
2. Acceptance of a list of generic "nomina conservata" to be prepared by a joint committee, the present list being taken as a general basis.
3. Treatment of generic homonyms as non-valid, with the exception of such as may be placed on the list of "nomina conservata."
4. Treatment of all specific homonyms as non-valid.
5. Abandonment of priority of position.
6. Abandonment of an obligatory Latin diagnosis of new groups; recommendation, however, that a Latin diagnosis should be supplied especially in cases where descriptions are published in languages which do not employ Roman characters.
7. Treatment of generic names as non-valid unless they are accompanied by a generic description or a reference to a former description (generic or sectional).
8. Treatment of generic names as non-valid unless they are associable with a simultaneously or previously published binomial specific name. Provision, however, to be made for the typification of important genera which would otherwise be invalidated under this rule.
9. Acceptance of duplicate binomials.

It should be mentioned that the above suggestions embody only my personal views, and are offered as a possible basis on which the Type-basis Code and International Rules might be harmonized. They differ in some respects from suggestions previously made by me (op. cit. 1921, 153; 1922, 129, 313), which were put forward entirely on their own merits, as a logical development of the present International Rules.

The acceptance of any basis of agreement will call for sacrifices on both sides. Is it too much to hope that they will be cheerfully offered in the common cause of the advancement of Systematic Botany?

T. A. SPRAGUE

ROYAL BOTANIC GARDENS,
KEW, ENGLAND

REMARKS ON MR. SPRAGUE'S SUGGESTION

THE International Rules of Botanical Nomenclature are familiar to botanists. The Type-basis Code was published in SCIENCE (49: 333. 1919; 53: 312. 1921). The differences were summarized by me in the British *Journal of Botany*. In the above article Mr. Sprague proposes a compromise. Personally I am in favor of a compromise along the lines he suggests. Practically this can best be accomplished at the next International Botanical Congress if the subject has been sufficiently considered previously by the taxonomic botanists of the world.

The question naturally arises, how many adherents of the International Rules are disposed to compromise? Mr. Sprague speaks only for himself. On the other hand, how many adherents of the Type-basis Code are willing to compromise? Being chairman of the Committee on Nomenclature of the Botanical Society of America, I must state plainly that in recording my disposition to compromise I am giving my personal views only.

It can not be expected that botanists will commit themselves in advance of a definite proposition formulated at a Botanical Congress. However, much can be gained in a preliminary way by a discussion. I would suggest that taxonomic botanists in America send me a statement of their views on the compromise suggested by Mr. Sprague.

A. S. HITCHCOCK

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

SPECIAL ARTICLES

A COMPARISON OF THE MORTALITY OF CERTAIN LOWER ORGANISMS WITH THAT OF MAN[1]

THE appropriate procedure for gaining an adequate scientific description of the mortality in any aggregate of living things is well understood, and has been widely practiced for nearly three centuries by vital statisticians and actuaries. It consists fundamentally in setting up, from observations over a sufficient time, the specific death rates at ages, for a chosen time unit, which unit in the case of man is commonly taken as one year. From these age specific death-rates all other actuarial functions of the mortality, such as survivorship, absolute mortality, expectation of life, etc., are derived, by mathematical procedures which are in essence simple enough, if sometimes complicated in the practical computations.

Now, while all this is well understood, when one embarks upon a comprehensive general biological investigation of the laws of mortality and duration of life, he is presently confronted with a practical difficulty. How shall he compare the mortality of two organisms whose total life spans are so widely different in extent of time that it is in practice quite impossible to measure or express them in the same unit?

In a recent paper Pearl[2] has suggested what appears to be a valid method of dealing with this difficulty, in making a comparison of the mortality of *Drosophila* with that of man. The nature of the solution is indicated in the following quotation from that paper:

> Upon what basis shall any life table function, say l_x, of the *Drosophila* life table be compared with that of man? The life span of one of these organisms is best measured in days, while that of the other is measured in years. This fact, however, offers no insuperable difficulty to the comparison. What is needed is to superimpose the two curves so that at least two *biologically equivalent points* coincide. The best two points would be the beginning and the end of the life span. But in the case of *Drosophila* our life tables start with the beginning of *imaginal* life only. The larval and pupal durations are omitted.
>
> I think we can get at this starting point . . . by putting the human and *Drosophila* l_x curves together as a starting point at the age for each organism *where the instantaneous death rate* q_x *is a minimum*. In the case of *Drosophila*, I think we are safe in concluding, on the basis of the work of Loeb and Northrop as well as from our own observations, that this point is at or very near the beginning of imaginal life. We shall accordingly take *Drosophila* age 1 day as this point. Our life tables show that certainly *after* this time q_x never again has so low a value.

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[1] Papers from the Department of Biometry and Vital Statistics, School of Hygiene and Public Health, the Johns Hopkins University, No. 85.

[2] Pearl R.: "Experimental studies on the duration of life. VI. A comparison of the laws of mortality in *Drosophila* and in man." *Amer. Nat.*, Vol. 56, pp. 398-405, 1922.

TABLE I

Observed and calculated q_x values from Noyes's data on Proales.

Days of life	Observed death rate (per 1000) within interval.	Calculated q_x	Calculated l_x (number living at beginning of each interval)
0- .9	0	.06	1000.0
1.0-1.9	1.4	1.39	999.9
2.0-2.9	9.6	9.99	998.5
3.0-3.9	47.3	44.98	988.5
4.0-4.9	136.5	144.60	944.0
5.0-5.9	393.9	349.90	807.5
6.0-6.9	575.9	653.50	525.0
7.0-7.9	1000.0	956.10	181.9
8.0-8.9	....	....	80.0
9.0-9.9	....	....	0

TABLE II

Survivorship distribution for each centile of the life span of Proales decipiens.

Centile of life span	Number alive at beginning of centile age interval.	Centile of life span	Number alive at beginning of centile age interval	Centile of life span	Number alive at beginning of centile age interval
0- 1	1000	34-35	991	68- 69	655
1- 2	1000	35-36	990	69- 70	630
2- 3	1000	36-37	988	70- 71	605
3- 4	1000	37-38	986	71- 72	579
4- 5	1000	38-39	984	72- 73	552
5- 6	1000	39-40	982	73- 74	525
6- 7	1000	40-41	979	74- 75	497
7- 8	1000	41-42	976	75- 76	469
8- 9	1000	42-43	973	76- 77	440
9-10	1000	43-44	969	77- 78	411
10-11	1000	44-45	965	78- 79	382
11-12	1000	45-46	960	79- 80	354
12-13	1000	46-47	955	80- 81	326
13-14	1000	47-48	950	81- 82	298
14-15	1000	48-49	944	82- 83	270
15-16	1000	49-50	937	83- 84	244
16-17	1000	50-51	930	84- 85	218
17-18	1000	51-52	922	85- 86	194
18-19	999	52-53	914	86- 87	171
19-20	999	53-54	905	87- 88	149
20-21	999	54-55	895	88- 89	128
21-22	999	55-56	884	89- 90	109
22-23	999	56-57	872	90- 91	91
23-24	999	57-58	859	91- 92	75
24-25	998	58-59	845	92- 93	61
25-26	998	59-60	830	93- 94	49
26-27	997	60-61	815	94- 95	38
27-28	997	61-62	799	95- 96	28
28-29	996	62-63	782	96- 97	20
29-30	996	63-64	763	97- 98	13
30-31	995	64-65	743	98- 99	8
31-32	994	65-66	723	99-100	4
32-33	993	66-67	701	100	1
33-34	992	67-68	678		

For the other end of the life span we may conveniently take the age at which there is left but *one* survivor out of 1,000 starting at age 1 day for *Drosophila* and age 12 years for white males.

When the above was written we were aware of the existence of complete life tables for only the two organisms *Drosophila* and man. Since then we have calculated a life table for a third form, the rotifer *Proales decipiens*, on the basis of data as to its mortality recently published by Dr. Bessie Noyes.[3] We wish to report the results here, and to compare them with the data for the other two organisms.

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[3] Noyes, B.: "Experimental studies on the life-history of a rotifer reproducing parthenogenetically (*Proales decipiens*). *Jour. Exp. Zool.*, Vol. 35, pp. 225-255, 1922.

Miss Noyes provides in her paper, in two different but apparently homogeneous series, data on the life history of 1,454 individuals. The observations were taken only once in 24 hours, an interval far too long to give a smooth curve for an animal having a maximum total life span of only about eight days. This fact makes the construction of a life table more difficult and much less accurate than if the observations had been more closely spaced. It is as though one tried to construct a life table for man from data as to age at death recorded only to the nearest decade.

Taking the data as they stand, however, the central death-rates were computed and graduated with the results shown in Table I.

The q_x values were graduated by the following expression (with origin at 0 age, or birth)

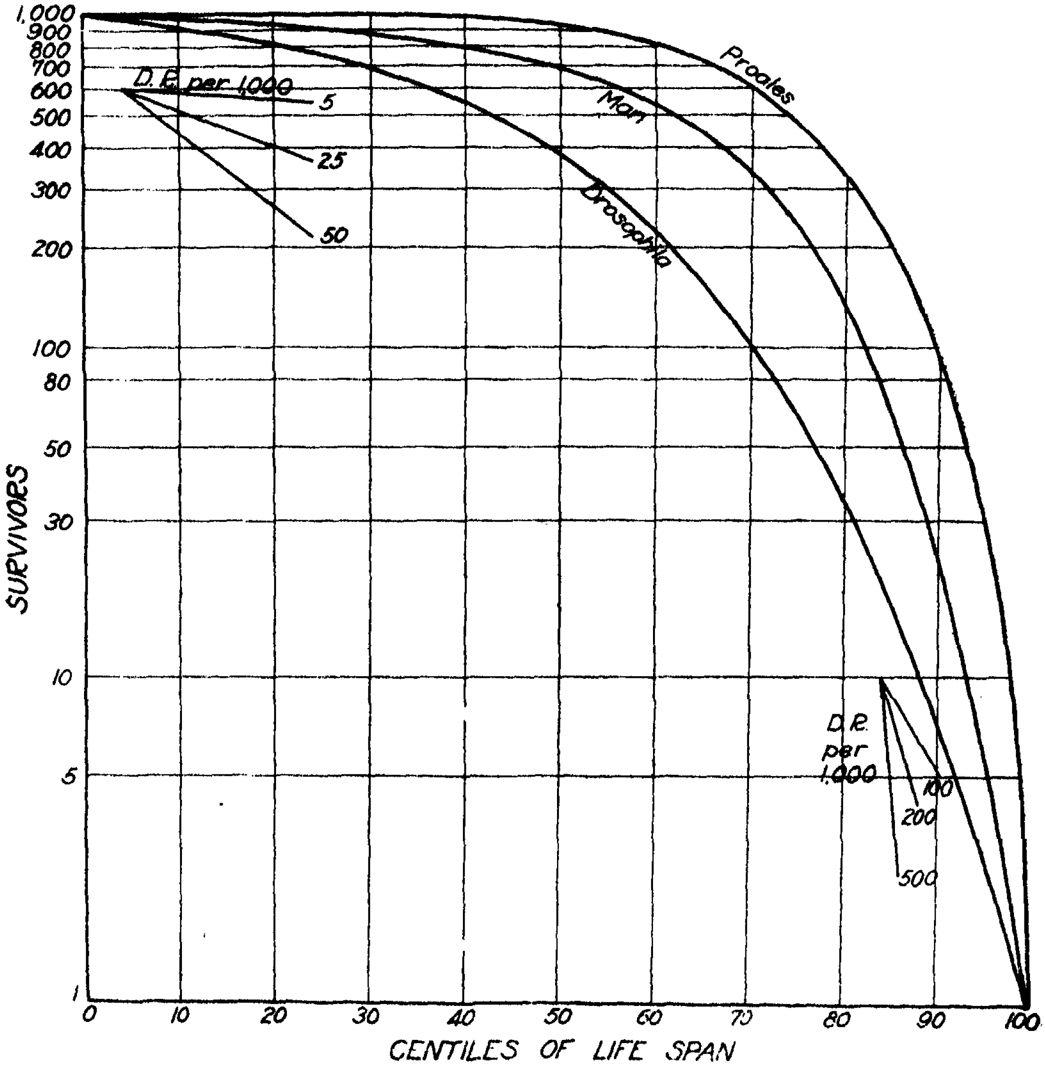

Fig. 1. Showing survivorship distributions for (*a*) rotifer *Proales decipiens*, (*b*) man (males in original registration states, 1910), and (*c*) *Drosophila melanogaster* (wild type males). The death rates corresponding to given slopes of the l_x line are also given by the groups of fine lines at the two ends of the diagram.

which is of a type found useful in previous work with *Drosophila* life curves:

$$\log q_x = -1.0783 + .7041x - .0452x^2 + 1.5080 \log x.$$

It is evident from the data of Table I that the fit is reasonably good, probably as good as one could expect with observations so rough in respect of age at death.

The next step is to calculate a *Proales* life table in terms of centiles of the life span rather than in absolute age. This was done in the same manner as in the earlier paper, and the results, so far as concerns the survivorship function l_x, are shown in Table II.

In order that it may be seen how the forces of mortality operate in *Proales* as compared with man and *Drosophila*, the diagram shown as Figure 1 is presented.

Comparing the three curves, we note the following points:

1. The *Proales* curve lies above the other two at all parts of the comparable life span. This means that out of 1,000 individuals starting together at biologically equivalent points in the life span (*i. e.*, at the age when q_x is a minimum for each organism) at any subsequent age centile there will be more surviving rotifers than men, and more surviving men than flies.

2. The median durations of life, or, put in another way, the ages prior to which just 500 of the 1,000 individuals starting together will have died, are approximately:

For *Proales*,	74 % of the equivalent life span.
For Man,	62 % of the equivalent life span.
For *Drosophila*,	42.5% of the equivalent life span.

3. The comparison the other way about indicates that when 50 per cent. of the equivalent life spans have been passed there are still surviving:

In *Proales*,	93.0% of the individuals starting.
In Man,	68.5% of the individuals starting.
In *Drosophila*,	38.0% of the individuals starting.

The outstanding thing about the life curve for *Proales* from Miss Noyes's figures is that it approaches nearer to the theoretically possible right-angled form, in which all the individuals live to a given age x and then all die at once, than any other that has yet been observed. Whether this is the result of (*a*) the greater uniformity of environment, on the average, for the *Proales* under the experimental conditions than for the other forms, or (*b*) the greater uniformity of the population in genetic constitution, consequent upon the fact that *Proales* reproduces parthenogenetically and that all of Miss Noyes's cultures were descended from at most not over six different individuals, or (*c*) a combination of both, can not be definitely stated. Both of the factors mentioned undoubtedly do in some degree operate to produce the form of life curve exhibited. There is need for data regarding the mortality of other organisms. It is an interesting commentary on the development of biology that the distribution of mortality in respect of age is known for only three species of animal life with sufficient accuracy to permit the formation of age-specific death rates, and hence of a life table. Into every discussion of the problem of evolution, and into every attempt to determine its causes, there must necessarily enter the question of the mortality of the forms being dealt with. There seems no good reason for indefinitely continuing to handle the matter by the current methods, which are either to make large *a priori* guesses about the distribution of mortality in the particular case, or to assume that it is the same as that of man. In the nearly universal neglect of the problem of mortality and duration of life, biologists have missed an interesting and obviously important field.

Raymond Pearl
Carl R. Doering

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION M—ENGINEERING

Vice-president and Chairman, F. M. Feiker.

Retiring Vice-president, J. B. Tyrrell.

Secretary, L. W. Wallace; Federation of American Engineering Societies, Brookings Building, 26 Jackson Square, Washington, D. C.

Engineering was represented at the fourth Boston meeting of the American Association for the Advancement of Science in two of the sections—in Section K (Social and Economic Sciences), of which Dr. Henry S. Graves, of the Yale Forest School, Yale University, is vice-president and chairman, and in Section M (Engineering), of which Mr. F. M. Feiker, vice-president, McGraw-Hill Company, Inc., New York, is vice-president and chairman.

The keynote of the joint session between Section M and Section K was "The relation of the engineer to conservation." John T. Black, State Health Commissioner, Hartford, Conn., presented a paper on conservation with reference to industrial waste; William S. Murr, of New York City, spoke on the conservation of power. Due to badly delayed train schedules, both Mr. O. C. Merrill, secretary of the Federal Water Power Commission, Washington, D. C., and General Harry Taylor, in charge of Government Flood Control Works, Corps of U. S. Army Engineers, Washington, D. C., were unable to present their papers. Mr. Merrill was to have spoken on the federal water power policy and its results, and Dr. Taylor was to have presented a paper on problems of flood control.

The afternoon meeting of Section M opened with an address paper by Mr. J. B. Tyrrell, of Toronto, Canada, retiring vice-president for Section M, who presented a remarkable paper on the "Growth of the mining industry in Canada." Mr. Tyrrell's address constituted an effective summing up of the mineral resources of that great section of the North American continent, and he pointed out the historical development of the mining industry in Canada with many dramatic allusions to early mining ventures and the later surveys made by the Geological Survey of Canada. Gold was discovered many years after the earlier explorers and trappers had overlooked it. In one case on the Hudson Bay trail the feet of the trappers wore smooth the vein of gold in the rock, and during the fall and winter the trappers going in and out of the wilderness polished the undiscovered vein with their moccasins.

The keynote of the afternoon meeting of Section M was "The place of the engineer in civilization," the principal paper being presented by Dr. Ira N. Hollis, president of the Worcester Polytechnic Institute. Dr. Hollis pointed out that from the dawn of history the emphasis has been placed upon the man who produces, and that the root names for producer in several of the earlier languages are synonymous with our definition of the term *engineer*. One phase or another of engineering activity enters into practically all the other arts and sciences. Doctor Hollis instanced the factor of transportation and communication as one vitally touching life and activities of men in all walks of life, and pointed out the engineer's place in the further development of transportation and communication systems in the world. Mr. Tyrrell, retiring vice-president, in his address, referred to the part that steam railway transportation has played in the development of the mining industry as a practical illustration of the engineer's place in utilizing our natural resources. Dr. Hollis, as did Mr. Warrington Emerson, another speaker of the afternoon, pointed out the need of the engineer's analytical study of facts for the solution of present-day problems, and both emphasized the idea that indirectly the engineer, because of his control of the instrument of production, is deeply concerned with present-day civilization.

The paper by Professor C. F. Scott, of Yale University, president of the Society for the promotion of Engineering Education, on "New phases of engineering education," was presented in Professor Scott's absence by Dr. Dugald C. Jackson. Professor Scott indicated that because engineering was coming to take such a large place in our modern life, it was essential that the training of engineers be approached with a new viewpoint of the engineer's place in the community.

The several contributions emphasized that the next step in engineering is to relate the problems of the material advance in civilization to the human problems of civilization. The engineer has an opportunity for leadership in approaching these human problems, which have grown out of his own contributions in increasing the perplexity of life, if he will apply the logic of his thinking with the understanding that human problems are problems of emotion, as well as of logic.

In the evening Calvin W. Rice, Secretary of the American Society of Mechanical Engineers, presented an illustrated address on the "Engineering and scientific development of South America."

SECTION N—MEDICAL SCIENCES

Vice-president and Chairman, Francis Weld Peabody.

Retiring Vice-president, A. B. Macallum.

Secretary for the Boston Meeting, A. J. Goldfarb; College of the City of New York, New York, N. Y.

(*Report by A. J. Goldfarb*)

Following a plan recently adopted by the section, there was held on Friday afternoon a session of invited papers on parasitology and entomology as these subjects are related to medical science. The new plan contemplates the bringing together of a group of men of science not specially provided for in any other organization, and it emphasized the unity of science in general. Somewhat as the geneticists of the Botanical Society of America and of the American Society of Zoologists have organized the Joint Genetics Section, it is planned that Section N may serve a very useful purpose to American science by bringing together research workers in the various scientific fields that contribute to medical science. This movement, together with the recent formation of the genetics section just mentioned, illustrates a new tendency in scientific organization, to form groups on the basis of fundamental relationships in the scientific results to be achieved and the general methods to be employed, rather than simply on the basis of the classification of the organisms or materials studied.

The new plan for Section N was first tried in the session at Boston. The program for that session was based on the fundamental relationships that hold between certain fields of medical science and those of parasitologists and entomologists. Dr. A. B. Macallum, of McGill University, retiring vice-president for the section, gave the vice-presidential address on "The necessity for advanced research on the intestinal mucosa, the great gateway of disease of the body," and medical science was also represented by Dr. Richard P. Strong, of the Harvard Medical School, who presented an invitation paper on "Some aspects of disease associated with the fields of zoölogy, entomology and parasitology." Entomology was represented by invitation papers by Dr. C. T. Brues, of the Bussey Institution, and by Dr. L. O. Howard, of the U. S. Department of Agriculture. Dr. Brues brought out the interesting fact that evidence is very strong for regarding poliomyelitis (infantile paralysis) as being spread mainly by rats and insects. Dr. C. A. Kofoid, of the University of California, and Dr. C. W. Stiles, of the U. S. Public Health Service, represented parasitology by invitation papers. The former spoke on "Incidence of the human intestinal protozoan infections in the United States," and the latter considered "Some medico-zoölogical phases of our immigration problems." Each speaker dealt on the inter-relations among the allied fields represented in the program, suggesting problems that might well be considered by those in related fields outside of his own. The program as a whole furnished an excellent example of the recent emphasis on the need of cooperation among scientific men.

The session was very well attended, there being 120 persons present, and great interest was manifest. It was voted that the general plan here tried for the first time should be adhered to for the future work of Section N.

SECTION O—AGRICULTURE

Vice-president and chairman, R. W. Thatcher.

Retiring vice-president, Jacob G. Lipman.

Secretary, P. E. Brown, Iowa State College, Ames, Iowa.

(*Report by P. E. Brown*)

Section O of the association met on Wednesday afternoon of the Convocation Week with an invitation program by representatives of various of the societies affiliated with the section. The address of the retiring vice-president for the section was given by Dr. J. G. Lipman, of the New Jersey Agricultural Experiment Station. Dr. Lipman read a paper on "Tendencies in agricultural research." He discussed the subject in a most comprehensive way, calling attention to the accomplishments of the past years, the demands of the present, the causes for these demands, and the way in which research is meeting the complicated problems of present-day agriculture. Dr. C. V. Piper presented a paper on "The forage situation in the United States," in which he discussed forage production in its broad relation to agriculture and emphasized the significant aspects of forage crop problems. Professor E. N. Wentworth discussed "The relation of genetics to the business of agriculture," showing the significance of the problems that the livestock interests have called upon the geneticists to solve. Dr. B. L. Hartwell enumerated some of the crop production problems which need attention and which are characterized by the title of his paper, "Between the lines of science in crop production." Dr. T. L. Lyon gave a paper entitled "A note on the correlation of crop response to potassium and calcium in certain soils."

President R. A. Pearson, of the Iowa State College, was elected vice-president and chairman for the section, and Dr. H. J. Wheeler, of Boston, was elected to the section committee. The section voted to affiliate with the Union of Biological Societies.

THE AMERICAN SOCIETY OF AGRONOMY

President, S. B. Haskell.

Secretary, P. E. Brown, Iowa State College, Ames, Iowa.

(Report by P. E. Brown)

The American Society of Agronomy held its winter meeting on Friday of the Convocation Week, with an attendance of about seventy-five. The program consisted of a symposium on "Soil toxicity in its relationships to economic crop production," arranged by B. L. Hartwell. Ten papers were presented on various phases of the toxicity problem—particularly organic and inorganic compounds, acidity, susceptibility, methods of diagnosis, immunity and some physiological aspects of the problem. The speakers included Dr. Oswald Schreiner, Dr. A. L. Whiting, Dr. A. G. McCall, Professor F. W. Morse, Dr. P. L. Gile, Dr. W. P. Kelley, Dr. G. N. Hoffer, Dr. R. W. Thatcher and Dr. B. E. Livingston. The program continued throughout the day, and lively discussions followed each paper, interest centering especially on the problems of soil acidity and the relation of aluminum to toxicity.

A joint dinner with Section O, arranged by a committee of the New England agronomists, was given at the Boston City Club on Thursday evening. About forty-five attended and enjoyed a carefully planned New England dinner. An extensive program was presided over by Dr. C. R. Ball, toastmaster.

Director S. B. Haskell, president of the society and local representative, was largely responsible for the success of the dinner and of the meeting.

THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE

President, J. C. Blair.

Secretary, C. P. Close, College Park, Md.

(Report of C. P. Close)

Professor J. H. Gourley, of the Ohio Agricultural Experiment Station, Wooster, Ohio, was elected president of the society for 1923. The following were elected as vice-presidents: Professor G. F. Potter, Durham, N. H., Professor H. A. Jones, Berkeley, Calif., and Professor T. G. Bunting, Macdonald College, Quebec. Professor C. P. Close was elected (to succeed himself) as secretary, and Professor R. E. Marshall was elected assistant secretary.

The society met in Room 2-180, of the Massachusetts Institute of Technology, the sessions beginning Wednesday morning, December 27, and continued through Friday afternoon. The program included fifty-nine papers, of which two reported studies on light relation, seven studies on temperature relations, ten teaching and extension work, eleven vegetable studies, nine breeding work and twenty studies in pomology.

THE SOCIETY OF AMERICAN FORESTERS

President, E. A. Sherman.

Secretary, W. N. Sparhawk; U. S. Forest Service, Washington, D. C.

(Report by W. N. Sparhawk)

The meetings of the Society of American Foresters on December 29 and 30 were the most successful ever held, both as regards attendance and interest and discussion of papers. The total attendance included more than 130 members and guests. Perhaps the most significant fact brought out at the meetings, as well as at those of the joint sessions with the New England Forestry Congress, was that in the northeastern states, at least, the time is now ripe for the application of technical forestry on a wide scale. Not only is systematic timber-growing desirable from the standpoint of general public welfare, but conditions have reached the point where it is a paying proposition for private individuals and corporations.

Resolutions were adopted urging the early establishment of forest experiment stations in

New England and the Lake states; continued acquisition by the Federal government of forest lands, under the Weeks Law; increased State and Federal appropriations for forest fire protection; and the following:

> *Whereas,* After a long career of distinguished service, Dr. Hopkins has resigned as chief of the Division of Forest Insects in the United States Bureau of Entomology, and
>
> *Whereas,* The depredations of forest insects constitute a vital factor in the problems confronting the forester, be it
>
> *Resolved,* That the Society of American Foresters recommends the appointment of an entomologist who, in addition to thorough technical training, possesses a rich practical experience in economic forest entomology and a close familiarity with the problems and methods of forest management.

The following officers were elected: *President,* Professor Ralph S. Hosmer, Cornell University, Ithaca, N. Y.; *Vice-president,* Professor Herman H. Chapman, Yale University, New Haven, Conn.; *Secretary,* William N. Sparhawk, U. S. Forest Service, Washington, D. C.; *Treasurer,* Fred W. Besley, State Forester, Baltimore, Md.; *Member of Executive Council (for five years, 1923-27),* Robert Y. Stuart, Forest Commissioner, Harrisburg, Pa.

THE SOCIETY FOR THE PROMOTION OF AGRICULTURAL SCIENCE

President, R. W. Thatcher.

Secretary-Treasurer, P. E. Brown, Iowa State College, Ames, Iowa.

(Report by P. E. Brown)

This society held a brief business session on Thursday afternoon and, after some discussion, voted to merge the society with Section O of the association, the details of the merging to be arranged by the officers of the society who fill corresponding offices in the Section.

GENETICISTS INTERESTED IN AGRICULTURE

Secretary, Edward N. Wentworth, Armour's Bureau of Agricultural Research and Economics, Chicago, Ill.

(Report by E. N. Wentworth)

Geneticists interested in agriculture met Wednesday morning preceding the meeting of the Genetics Sections of the American Society of Zoologists and the Botanical Society of America. The general topic of discussion was "The place of genetics in the agricultural experiment stations." Dr. John W. Gowen, of the University of Maine discussed "The future possibilities for fundamental research in the experiment stations." He called attention to the growing difficulties of financing the stations based on the lowered purchasing price of the dollar, the consequent limitation of funds for research purposes and the increasing pressure from the outside for research giving promise of immediate results in the hope of offsetting the agricultural stringency. Dr. E. W. Lindstrom, of the Iowa State College discussed "The relation of the genetics department to the applied departments." He called attention to the difficulty of making genetic problems fit into the research program of the applied departments and at the same time stressed the fact that requests could not be made for a broad duplication of equipment for animal and plant breeding in order that the genetic research might proceed without interruption. His final decision was that the geneticists must be equipped for applied research in some one field and cooperate by advice and research assistance in other fields. The geneticists interested in agriculture form a temporary organization only, holding meetings at times when live topics of discussion exist, and dealing particularly with problems of organization and procedure in the agricultural colleges. The secretary *ad interim* for 1923 is Dr. E. W. Lindstrom, Iowa State College, Ames, Iowa.

THE POTATO ASSOCIATION OF AMERICA

President, J. G. Milward.

Secretary, William Stuart, U. S. Department of Agriculture, Washington, D. C.

(Report by William Stuart)

The annual meeting of the Potato Association of America, which was held at the Massachusetts Insitute of Technology, December 27-29, 1922, proved to be one of the most interesting meetings thus far held by this association.

One of the worth-while features of this meeting was that of the joint session held by the association with that of the Phytopathological Society for the purpose of a free discussion of seed potato certification standards. Owing to lack of time the chairman of this conference found it impossible to cover the whole subject involved in seed certification work, thereby making it necessary to postpone its completion until the following afternoon. While no definite action was taken regarding the adoption of uniform inspection rules, it is believed that the ultimate good resulting from this conference will serve to very materially aid in the conduct of this work.

The attendance, while not large at any given session, except the one devoted to a joint conference with the pathologists, was largely made up of persons intensely interested in the improvement of the potato industry. The papers presented and the discussion they evoked were brief, snappy and very much to the point.

The following resolutions were presented by the Resolutions Committee and unanimously adopted by the members present:

Whereas, We feel that the specific functions of this association as stipulated in the constitution can be more efficiently and more fully carried out by closer connection and cooperation with all potato organizations of the United States and Canada; be it therefore

Resolved, That we invite all such organizations to take out memberships for its officers or executive boards and wherever practicable to send at least one delegate to our annual meeting; and be it further

Resolved, That such delegates bring to the meeting their local and regional problems in order that they may be brought to the attention of the specialists best fitted to deal with them. Be it further

Resolved, That this association desires to express its appreciation of the courtesies extended to it by the Massachusetts Institute of Technology and that a copy of this resolution be transmitted to the proper authorities.

At the conclusion of the afternoon session, Friday, December 29, the following officers were elected for the ensuing year: *President,* Dr. W. H. Martin, Experiment Station, New Brunswick, N. J.; *Vice-president,* G. C. Cunningham, Agricultural Department, Fredericton, N. B.; *Secreary-treasurer,* W. Stuart, U. S. Department of Agriculture, Washington, D. C.; *Assistant Secretary-treasurer,* W. M. Peacock, U. S. Department of Agriculture, Washington, D. C.

The Executive Committee consists of the president, vice-president, secretary-treasurer, the retiring president, J. G. Milward, Experiment Station, Madison, Wisconsin, and H. R. Talmage, Riverhead (L. I.), N. Y.

SECTION Q—EDUCATION

Vice-president and Chairman, Bird T. Baldwin.

Retiring Vice-president, Guy M. Whipple.

Secretary, A. S. Barr, 1924 Hazelwood, Detroit, Mich.

(No report received. The permanent secretary has been obliged to supply what follows.)

Five sessions of Section Q were held, in the Fogg Art Museum of Harvard University, on Wednesday, Thursday and Friday forenoons, and on Wednesday and Thursday afternoons. The first session was addressed by J. C. Manry, University of Iowa, A. I. Gates, Columbia University, and W. F. Dearborn, Harvard University. Informational education and international affairs were discussed.

The second session, held jointly with the honor society, *Phi Delta Kappa,* gave special attention to needed research in elementary, secondary and college education, with papers by William S. Gray, University of Chicago, George S. Counts, Yale University, and Leonard Koos, University of Minnesota. S. A. Courtis and Charles L. Spain, both of the Detroit public schools, spoke on the selection of judges for judgment scales and the platoon organization, respectively.

At the third session were presented papers on rating, by Charles H. Bean, Louisiana State University, and F. A. Kingsbury, University of Chicago. Frank N. Freeman, University of Chicago, spoke on the value of motion pictures in the teaching of writing, with interesting illustrations showing groups of children in good and poor positions for handwriting. Groups to whom these films had been shown advanced much more rapidly in this respect than did other children who had not seen the films. Willis L. Uhl, University of Wisconsin, reported on a recent attempt to develop an improved set of standards for the selection of material for reading and literaure in elementary and high schools. Over 7,000 reading selections were judged by over 3,000 teachers. The main objectives are: mastery of the mechanics of reading, comprehension of what is read, and development of literary culture.

At the fourth session was given the retiring address of Guy M. Whipple, of the University of Michigan, retiring vice-president of the American Association for the Advancement of Science for Section Q. This was followed by a business session, at which Dean Henry W. Holmes, of Harvard University, was nominated to the council for chairman of the Section and vice-president of the American Association for the Advancement of Science for 1923. A. S. Barr was nominated to the council for secretary of the section for the remainder of the term, which ends at the close of the Washington meeting, December, 1924. The newly elected members of the Section Committee for Section Q are: Wm. S. Gray (retiring 1926), School of Education, University of Chicago, and Guy M. Whipple (retiring 1925), School of Education, University of Michigan.

The fifth session dealt largely with tests of intelligence, character, etc., with papers by J. M. Brewer, Harvard University; O. R. Chambers, Ohio State University; and others.

SECTION X—SCIENTIFIC SOCIETIES RELATED TO THE AMERICAN ASSOCIATION IN GENERAL

Society of Sigma XI.

President, Henry B. Ward.

Secretary, Edward Ellery; Union College, Schenectady, N. Y.

(*Report by Edward Ellery.*)

The annual American convention of Sigma XI was held in connection with the meetings of the Association for the Advancement of Science, December 27. The business session convened at 2:30, the president, Professor H. B. Ward, of the University of Illinois, presiding. Thirty-two of the thirty-nine chapters were represented by delegates, this being the largest number of delegates ever registered at a convention of the society. The chief items of business were petitions for chapters from the University of Oregon and Swarthmore College and the consideration of a new constitution. Both petitions for charters were granted. The new constitution, as proposed at the convention of a year ago, was adopted with minor changes and provides for a simpler classification of members and a closer union of alumni members with the active organization.

The annual dinner was held in the Walker Memorial with 170 in attendance. President Ward acted as toastmaster and introduced President Moore of the association, President Farrand of Cornell University, Professor Stafford of the University of Oregon, Professor Marriott of Swarthmore and Professor Webster of Clark University.

The first annual Sigma Xi public lecture given in a joint meting with the association was delivered by President Farrand of Cornell University in the main building of the Institute of Technology. Dr. Farrand chose for his topic "The nation and its health." He was enthusiastically received by a large audience.

Professor F. K. Richtmyer, of Cornell University, was re-elected a member of the executive committee.

Phi Kappa Phi

President General, J. S. Stevens.

Secretary General, L. H. Pamnel, Ames, Iowa.

An informal business meeting formed the only session of this society.

Sigma Delta Epsilon

President, Christianna Smith.

Secretary, Evelyn Fernald, Ithaca, N. Y.

Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, held its first National Convention at the Boston meetings. Amendments to the constitution were recommended by the convention, and membership qualifications and expansion were discussed. A luncheon was held for those interested at The Hotel Essex on December 28, at which Mrs. Anna Botsford Comstock and Miss Christianna Smith spoke on the need of organization among women and what had been accomplished by the two chapters at Cornell University and the University of Wisconsin.

The following national officers were elected at the convention: *President,* Miss Christianna Smith, Dept. of Histology and Embryology, Cornell Univ., Ithaca, N. Y.; *First Vice-president,* Dr. Elizabeth Smith, Dept. of Zoology, Univ. of Wisconsin, Madison, Wis.; *Second Vice-president,* Miss C. Audrey Richards, U. S. Dept. of Forest Pathology, Madison, Wis.; *Secretary,* Miss Evelyn I. Fernald, Dept. of Botany, Cornell Univ., Ithaca, N. Y.; *Treasurer,* Miss Helen Johann, U. S. Dept. of Plant Pathology, Madison, Wis.

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IDEALS OF THE TELEPHONE SERVICE[1]

A TRIBUTE TO THE MEMORY OF ALEXANDER GRAHAM BELL

THIS is the ninth annual meeting of the Telephone Pioneers of America, although our association is now entering upon its twelfth year. On account of the war, during three years no annual meetings were held. The pioneers were then engaged in the great struggle to save civilization.

The membership of our association is made up not only from those who took part in the first development of the telephone, but also from those who have been in the telephone service for a period of twenty-one years. We have in the service tens of thousands of zealous men and women doing pioneer work now, but because they lack in years, though not in achievement, they have not been enrolled. We and they are looking forward to the day of their formal admission. To these our fellow-workers we extend our greetings and our appreciations. In their hands lies not only the future of our society but the future of our art.

Our first meeting took place eleven years ago, at Boston, the birthplace of the telephone. At that meeting, the inventor of the telephone, Alexander Graham Bell, was present and delivered to us an address which must always be memorable in the history of our society. To-day, we recall with peculiar sadness these words which he then spoke to us:

"This is a great day for me, the first meeting of the Telephone Pioneers of America and of the world. It gives me great pleasure to meet with you all to-day, and yet there is a feeling of sadness about it. I am the first telephone pioneer and my memory goes back to the very beginning, and I miss the faces I remember so well, the faces of the old pioneers who I wish were here to-day. . . . I feel it a little presumptuous on my part to try to speak of the telephone to telephone men. You have all gone so far beyond me. Why, the little telephone system that I look back upon, what is it compared to the mighty system that goes through the whole extent of our country to-day? It is to you that this great telephone development is due, and I feel that it behooves me to speak very modestly of the little beginning that led to this great end. I can not tell you anything about the telephone. I can not speak to you about undulating current, intermittent current and pulsatory current. I belong to the past; you belong to the present.''

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[1] Presidential address delivered at the ninth annual meeting of the Telephone Pioneers of America, at Cleveland, Ohio, September 29, 1922.

Here stand revealed those lovable qualities of the great pioneer—generosity and modesty—which endeared him to us all. It is true, indeed, that he belongs to the past, though then he still belonged to the present. Now he belongs to the ages.

Alexander Graham Bell died on Wednesday, August 2, at the age of seventy-five, at his summer home in Nova Scotia, near Baddeck. He was buried on August 4, at sunset, on the summit of a mountain overlooking the Bras d'Or Lakes. As a tribute to his memory, telephone service was suspended for one minute throughout the United States and Canada during the simple ceremony.

The manifold activities of his life, devoted to the service of mankind, would require volumes to portray. The medals and other honors which he received from learned societies, his honorary degrees from universities at home and abroad, and special recognition by governments, all testify to the esteem in which he was held. His scientific researches in the field of heredity and eugenics, his experiments in aeronautics, his work in improving the phonograph and in teaching the dumb to talk, and his invention of the photophone, reveal the scope of his mind. This record alone is enough to insure his fame, but his discovery of the method of transmitting articulate speech by electricity, and his invention of the apparatus to do this, have placed his name among the immortals.

Dr. Bell was born on March 3, 1847, in Edinburgh, Scotland. He went to Canada in 1870, and the next year, at the age of twenty-four, he removed to Boston. After introducing into New England schools improved methods of teaching deaf mutes to speak, he was appointed professor of vocal physiology in Boston University.

In his spare time, he conducted experimental researches in electrical wave transmission. He was *assisted financially in these experiments* by two gentlemen of Boston, Thomas Sanders and Gardiner Greene Hubbard. By the summer of 1874, he had worked out his theory that the transmission of speech by electricity could be accomplished by producing "electrical undulations similar in form to the vibrations of the air" which accompany the original words or sounds. In spite of great difficulties and discouragements, he succeeded in reducing his theory to practical form, when, at Boston, in the summer of 1875, he invented a telephone which faintly transmitted parts of words and even entire words.

Mr. Thomas A. Watson, Bell's assistant, relates that it was on March 10, 1876, over a line extending between two rooms in a building at No. 5 Exeter Place, Boston, that the first complete sentence was ever spoken and heard through the electrical telephone. It was spoken by Bell and heard by Watson, who recorded it in his note book at the time. It consisted of these words: "Mr. Watson, come here; I want you." Thus the telephone was born.

After completing his fundamental invention, Bell in a remarkable document predicted with amazing foresight the telephone system of the future. He also invented the photophone, which was the first method of transmitting speech by electricity without wires, and the induction balance and the telephone probe for which he was awarded the honorary degree of doctor of medicine by the University of Heidelberg. To his successors in the laboratories in which he was the original worker, he left the further conduct of telephone research and development.

Turning to other departments of science, he displayed his remarkable intellectual gifts by the fruitful researches which he conducted. In his work on behalf of the deaf, which he continued to the end, is revealed a dominant motive in his life.

To Bell was accorded a privilege so often denied to those who have advanced the world by their discoveries—he lived to see the triumph of his great idea. When the first sentence was transmitted, the public regarded the telephone as a scientific toy. Then, the telephone plant of the entire world could be carried in the arms of a child. To-day, vast telephone systems of intercommunication have been developed, extending the spoken word among the peoples of the nations.

The advances of the telephone art made by the successors of Bell were always a source of great satisfaction to him. Some of these, epoch-making in their nature, gave him special gratification.

On January 25, 1915, the transcontinental line, spanning Bell's adopted country from ocean to ocean, was in the presence of dignitaries of state and nation dedicated to the public service. This was a day of triumph for Bell, for, using a reproduction of the original instrument, he once again spoke the memorable words, "Mr. Watson, come here; I want you." But this time Bell was at New York, and Watson, who heard him with perfect ease, was three thousand miles away in San Francisco.

Another advance attained the greatest distance over which the transmission of speech had ever been achieved. Early in the morning of September 30, 1915, words were spoken through a radio telephone at Arlington, Virginia, to the Hawaiian Islands, where they were plainly heard. But, as if to proclaim the telephonic conquest of time as well as space, the words reached these distant islands of the Pacific when it was there still the evening of September 29.

There yet remained to be realized that prophetic dream of the telephone pioneers—the bridging of the Atlantic by the human voice. But the day of its fulfilment was not far off, for on October 21, 1915, during the dark days of the war, speech was for the first time in history successfully transmitted across the Atlantic Ocean. This was accomplished by the radio telephone, which carried the words spoken at Arlington to the Eiffel Tower at Paris.

The last memorable telephone development destined to occur in the life of Bell will always be associated with a great historic occasion. At the burial of the Unknown Soldier at Arlington, on November 11, 1921, the voice of President Harding, by means of the new loud speaking amplifiers, was easily heard by the great concourse of a hundred thousand people about him, even by those in the most distant parts of the vast cemetery. Corresponding multitudes numbered by tens of thousands, at New York and San Francisco, heard over the wires every word spoken by their chief magistrate, as clearly as though in his actual presence. These distant multitudes heard also the invocation of the chaplain, the music and the hymns and the words of the commitment service used by the bishop at the grave. They joined with each other and with those at the cemetery in the singing of the hymns, and they united with the President in reciting the Lord's Prayer with which he closed his address. They heard in amazement the salvos of artillery fired at the grave, and even those on the shores of the Pacific caught the loud reverberations thrown back by the Virginia hills. At the end, in profound silence and with heads bowed in sorrow, they listened to the plaintive notes of the trumpet sounding the soldiers' last farewell.

On that day, the achievements of science imparted a mystical power to the most solemn national ceremony in the history of America. This ceremony, its deep significance so enriched by the art of Bell, we can now believe contained an exalted sanction of the greatest of all the achievements of his life.

These are but some of the advances which have been made in the first half century of the telephone art, which is now drawing to a close. They belong to the golden age of communications which has achieved the extension of the spoken word throughout both space and time.

But this golden age has not yet ended, and when we contemplate the possibilities of the future we discover that it has only just begun. It is to the future that we must now turn our minds and direct our endeavors. It is true that we pioneers belong to the past, but it is equally true that we belong to the present. As individuals, we must all pass away, as did the first pioneer; but our association, the Telephone Pioneers of America, will continue to live. The greatest work which our society can do is to exemplify the ideals of our service, and to transmit to its future members the splendid traditions of our art. It should be our purpose to encourage and to sustain among the men and women of the telephone system their ever-increasing zeal for the public service.

While it is beyond my power to put into words these ideals of our service, they already exist within your hearts and mine, where we all can feel, though I can not express, their potency. These feelings, which form the mainspring of our actions, do not arise from mere wishful thinking, nor do they spring from an idealism which is disconnected from reality. They rest upon a solid basis of achievement, and represent the practical purpose of that great telephone system of intercommunication which bears the name of our first pioneer.

It is interesting to note that the biologists were the first to appreciate the peculiar importance of electrical communications in the social organism, and to Herbert Spencer, writing more than fifty years ago, we are indebted for some analogies which have not yet been sufficiently studied either by the biologist or the engineer. In tracing the analogy between the telegraph system of his day and the nervous system of the animal organism, Spencer expressed the view that probably when the then rudimentary telegraph systems were more fully developed, other analogies would be traceable. This development has already been provided by the telephone art, and national telephone networks have now become a vital part of the social organism. I believe that the study of these networks from the standpoint of biology is destined to yield important results, and, indeed, that an investigation of the remarkable developments of the automatic machinery used in modern telephone switchboards might even throw light on the mechanism of the mind itself.

Scientists have long been studying the theory that man has advanced to his present high estate by upward progress in the biological scale from a microscopic speck of protoplasm forming the biological cell or unit of life. They have pictured him as composed of countless millions of these living creatures forming an organic entity marvelously designed, each cell performing its allotted part in that exquisite division of labor which characterizes this biological state.

We commonly compare a nation to a complex living organism. "We speak of the body politic, of the functions of its several parts, of its growth and of its diseases, as though it were a creature. But we usually employ these expressions as metaphors, little suspecting," as Spencer says, "how close is the analogy, and how far it will bear carrying out. So completely, however, is a society organized upon the same system as an individual being, that we may almost say that there is something more than analogy between them."

Each cell has its allotted and specialized work to do. Each cell must be fed, and live, and grow. Sustenance must be obtained, prepared and assimilated, and the waste removed. The physiological mechanisms for doing these things and many other things besides have their striking counterparts in the structure of organized society, and furnish instructive material for the philosophic student. But to us of the telephone art, the most marvelous thing of all is the nervous system, that inconceivably complex communication network, by which the activities of both individual and society are regulated and without which paralysis and death would result.

We are told that the cells which compose the nervous system are the latest to appear in the upward march of the organism, and that the degree of their complexity and the extent of their differentiation furnish a criterion for determining the stage of progress which has been attained. Because of the high function, almost spiritual in its nature, performed by these nerve cells, they have been called the noble cells. I have long felt and often expressed the feeling that because of this the workers in the telephone art are engaged in a high calling, building up the noble cells which constitute the nervous system of the nation.

As in the animal body these cells were the latest to appear, so in the structure of organized society the highest form of electrical communication, the telephone, is the latest to appear—it comes only at the stage of higher development. And again as in the animal body, the stage of development of the nervous system is an index of its place in the evolutionary series, so I believe it will be found in any social organism that the degree of development reached by its telephone system will be an important indication of the progress which it has made in attaining coordination and solidarity.

The use of the spoken word to convey ideas distinguishes man from all other created things. The extension of the spoken word by means of electrical systems of intercommunication serves to connect the nervous system of each unit of society with all of the others, thus providing *an indispensable element* in the structure of that inconceivably great and powerful organism which many biologists feel is to be the ultimate outcome of the stupendous evolution which society is undergoing.

That such an organism, thus so magnificently conceived, would be the outcome of the higher evolution of man, I have long believed; but its form and the nature of its functioning, I could not imagine. But the great work of Trotter, who has studied the gregarious instinct in the lower animals and in man, permits us to contemplate this evolutionary entity from a new point of view. He has pointed out that nature, having failed in her giant organisms, in which so many individual cells were crowded into such animals as her giant lizards and the mammoth and the mastodon, was to try a new method which was to dispense with gross physical aggregations of cells combined into one body. He points out that the flock, the herd, the pack, the swarm—new organizations—were to be devised by nature, and to flourish and range throughout the world, and that in one of these new organizations, human society, the individual man is still to be regarded as the unit, but not constrained as is the cell in the animal body, but free to move about, the mind alone being incorporated into the new unit by the marvelous power of intercommunication. He shows that the power of these organisms depends on the capacity for intercommunication among their members, and that this power expands until the limits of this intercommunication are reached.

How fundamental electrical communication systems are, in the tremendous evolution of the human race which is now being manifested in the organization of society, and how vital to the welfare of mankind is the daily work of telephone men and women everywhere, is being made more and more apparent by the discoveries of the new school of biologists.

Speaking always of communication in its broadest meaning,[2] but emphasizing the importance of speech, Trotter says: "The capacity for free intercommunication between individuals of the species has meant so much in the evolution of man, and will certainly come in the future to mean so incalculably more, that it can not be regarded as anything less than a master element in the shaping of his destiny."

And again, in speaking of human society as a gregarious unit, he says: "The ultimate and singular source of *inexhaustible* moral power in a gregarious unit is the perfection of communion amongst its individual members."

As long as intercommunication was limited, he tells us, the full possibilities of nature's new experiment were concealed. But at length appeared man, a creature endowed with speech, in whom this capacity for intercommunication could develop indefinitely. "At once a power of a new magnitude was manifest. Puny as were his individuals, man's capacity for communication soon made him master of the world. . . . In his very flesh and bones is the impulse towards closer and closer union in larger and larger fellowships. To-day he is fighting his way towards that goal, fighting for the perfect unit which nature has so long foreshadowed, in which there shall be a complete communion of its members, unobstructed by egoism or hatred, by harshness or arrogance or the wolfish lust for blood. That perfect unit will be a new creature, recognizable as a single entity; to its million-minded power and knowledge no barrier will be insurmountable, no gulf impassable, no task too great."[3]

Here we have portrayed the forward march of humanity toiling ever onward to attain its goal. The realization that their wonderful art is destined to play such an important part in this final attainment, opens up a never-ending source of power and inspiration for telephone men and women everywhere. It adds new dignity to their calling. Already, as we have seen, the human voice has been carried with the speed of light across the Atlantic Ocean, and across our continent, and far out into the Pacific; but still greater things are to come.

It is the mission of the pioneers and their successors, and their associates among all the nations, to build up a telephone system extending to every part of the world, connecting together all the peoples of the earth. I believe that the art which was founded by Alexander Graham Bell, our first pioneer, will provide the means for transmitting throughout the earth a great voice proclaiming the dawn of a new era in which will be realized that grandest of all our earthly aspirations—the brotherhood of man.

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[2] In this should be included all methods of communication based upon speech, such as newspapers, books and letters, depending upon mechanical transportation; and telegrams, depending upon electrical transmission.

[3] W. Trotter: "Instincts of the Herd in Peace and War."

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AMERICAN TELEPHONE AND
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THE AGGLUTINATION OF BACTERIA[1]

ONE of the characteristic properties of suspensions of finely divided matter in general and of bacteria in particular is the fact that under certain conditions the particles remain discrete, whereas, under other conditions, they collect into larger aggregates, *i. e.*, they agglutinate. This aggregation or agglutination is caused by certain concentrations of salts or acids and in the case of suspensions of bacteria by proteins and especially by the homologous immune serum. It is evident, therefore, that there must be a force which tends to keep the individual particles apart from each other, and another force which tends to hold them in contact. It has long been known that such particles carry an electric charge with reference to the surrounding liquid and it was early suggested that it was the repulsion due to the charge carried by the organisms which prevented them from coming into contact; the attractive force has usually been assumed to be surface tension. Many experiments have been performed to test this relation of the charge on the particles to the stability of the suspension, but nearly all have failed to show any definite relationship between the two phenomena. An exception is the work of Powis[2] on the coagulation of oil emulsions. Powis found that coagulation occurred whenever the potential between the drops and the surrounding liquid was reduced below a critical value of about 30 millivolts. The stability of these oil emulsions therefore is determined solely by the potential of the droplets. In the case of bacteria, however, it has been found repeatedly that agglutination, especially by immune serum, may occur without any change in the potential. Some qualitative relation has been found between the acid agglutination point and the potential inasmuch as the potential passes through a minimum and changes its sign at the acid agglutination point.

It will be evident from the result of the experiments reported here that the difficulty with the bacteria suspensions is due to the fact that electrolytes affect not only the potential and hence the repellent force but also the cohesive or attractive force. In order to account for the observations it is therefore necessary to measure *both.*

The experiments performed by the writers were carried out with thoroughly washed suspensions of *B. typhosus* and the bacillus of rabbit septicemia. The potential was calculated from the rate of migration of the organisms in an electric field.

AGGLUTINATION BY SALTS OR ACIDS

It was found that the experiments could be divided at once into two groups; first, those in which agglutination was caused by very low concentrations (less than 0.01 N), and second, those in which high concentrations of electrolytes were needed. In the first group it was found that agglutination occurred whenever the potential between the organisms and the solution was reduced below about 13 millivolts (either positive or negative). In this case apparently the stability is determined solely by the potential. In the second group, however, there was no critical potential and agglutination with many salts did not occur even though the potential was reduced to a value too small to measure. This distinction between the two groups is not due to a specific effect of the salt, since the presence of a high concentration of sodium chloride for instance, which does not cause agglutination in any concentration, completely prevents agglutination by acids.[3]

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[1] A detailed account of the work described in this paper has been published in the *J. Gen. Physiol.*, July and November, 1922. References to other work will also be found in these papers and have been omitted from the present summary.

[2] Powis, F.: *Z. physik. Chem.*, 1914-15, lxxxix, 186.

[3] It follows from this experiment that in determining the acid agglutination point of bacteria

It is evident from the above results that the agglutination in general can not be accounted for solely by changes in the potential. The results, however, are what might be expected if the salt affected the attractive or "cohesive" force as well as the potential. It was found possible to obtain a comparative measure of the adhesive force by determining the force required to separate two glass discs covered with a film of the bacteria. These experiments confirmed the supposition mentioned above. They showed that high concentrations of salt decreased the attractive force between the organisms. Although the potential required to keep them apart is also decreased, and in very concentrated salt is reduced to zero, the cohesive force is so insignificant that the organisms do not agglutinate, despite the absence of potential.

AGGLUTINATION BY MEANS OF PROTEINS

The agglutinating action of various proteins was found to be the same as that of salts, except that no effect on the cohesive force was noted. The addition of the protein affects the potential and if the potential is decreased below the critical value agglutination occurs. If the potential is *increased* the suspension becomes more stable. This is evidently part of the mechanism of the so-called "protective colloids." The amount of protein required to reduce the potential to the critical value and to cause agglutination varies markedly with the p_H and is much less when the protein and bacteria carry charges of opposite sign. When the bacteria and protein both have the same sign, the charge on the bacteria may be *increased.* This experiment shows conclusively that the union between protein and bacteria is not determined solely by the attraction due to opposite charges since according to this view no combination should occur when the two have the same sign. It appears probable that the union is governed by secondary valence forces and is of the same type as the reactions studied by Langmuir in the formation of surface films. The isoelectric point of organisms coated with a protein is changed to that of the protein.

THE MECHANISM OF AGGLUTINATION WITH NORMAL AND IMMUNE SERUM

The effect of normal or immune serum was found to depend on the conditions of the experiment, especially as regards the salt concentration. If dialyzed serum is added to a suspension of organisms in distilled water, the potential of the organisms is gradually decreased but not sufficiently to cause agglutination (in the case of typhoid bacilli), *i. e.*, the potential is still greater than 13 millivolts. If *any* salt solution is now added to this mixture until the potential is decreased to the critical value of 13 millivolts, agglutination occurs. In other words, the immune serum prevents the salt from decreasing the cohesive force between the organisms and the agglutination of organisms treated with immune serum is determined simply by the potential. The agglutination of organisms sensitized with immune serum therefore takes place whenever sufficient electrolyte is added to reduce the potential to the critical value of about 13 millivolts. An excess of trivalent ions or of some divalent ions may cause the potential to change its sign and become greater than the critical value again, in which case the suspension again becomes stable.

If the experiment is performed in the usual way by adding the serum to a suspension of the organisms in salt solution, the mechanism is different. As has already been stated, the addition of ordinary neutral salts such as NaCl in fairly high concentrations to a suspension of bacteria depresses the potential to a very small value but agglutination does not occur owing to the fact that the cohesive force is also decreased, so that although there is no force keeping the organisms apart, neither is there any force to draw them together and no agglutination occurs. If now immune serum is added to this suspension of bacteria in salt solution it is found that very little or no change is caused in the potential but that the cohesive force is increased and agglutination therefore takes place. When the experiment is performed in this way, therefore, the mechanism is just the reverse of the one described above in which the salt was added to the mixture of serum and organisms. When the salt is added to the mixture

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buffer solutions of high concentration should not be used, but the experiments should be made with dilutions of a suitable acid.

of serum and organisms the cohesive force remains constant, but the potential and therefore the repulsion between the organisms is decreased until it is less than the cohesive force and agglutination therefore occurs. When, however, the serum is added to the organisms in the presence of sufficient salt so that the potential is less than 13 millivolts, the cohesive force is increased with increasing concentration of serum until it is greater than the repulsion due to the potential (which is not affected by the addition of the serum) and agglutination again occurs.

INFLUENCE OF THE p_H

It was found that the acidity of the solution markedly affects the amount of either normal or immune serum required to cause agglutination (when the organisms are suspended in low concentrations of salt). The nearer the isoelectric (acid agglutination) point of the organism the less serum is required for agglutination. A determination of the amount of antibody combined with the organism, however, showed no increase in this range. The number of units combined was the same from p_H 3.5 to p_H 8, although the amount of serum required to cause agglutination varied tremendously over this range of p_H. The same amount of antibody when combined with the organisms therefore evidently has a far greater effect in this range of p_H than it has farther from the isoelectric point or else other constituents of the serum have a greater effect near the isoelectric point of the organism. In any case, there seems to be no connection between the sign of charge of the antibody and organism and the combination between the two. This experiment indicates that the serum or protein forms a film on the surface of the organism which then reacts like a particle of the pure protein. A similar mechanism was suggested by Coulter[4] to account for the effect of serum on the acid-agglutination point of red blood cells.

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NEW YORK

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[4] Coulter, C. B.: *J. Gen. Physiol.*, 1921-22, iv, 403.

THE WORK OF U. S. GEOLOGICAL SURVEY

EXPLORATIONS for potash, investigations and explorations of present and possible oil and gas fields, of coal fields, and of ore deposits and mining districts, paleontologic researches, work in chemistry and physics, and investigations of surface and underground water resources are among the year's activities of the United States Geological Survey as mentioned in the annual report of the director, just made public. The number of employees in the Geological Survey holding regular appointments was 877; most of them are field men whose varied work ramifies into every state, in addition to Alaska and other outlying territory of the United States. Besides these a small host of temporary camp field men were employed—rodmen, teamsters, cooks, etc. Some of the most important things that the Geological Survey has to show for its work are geologic surveys which cover a wide scope of practical and scientific activity, embracing 32 states; topographic mapping in 21 states covering 13,544 square miles and including more than 5,000 miles of levels and primary traverse lines; more than 11,000 measurements of stream flow in 31 states and investigations of underground waters in 10 states.

The survey also acted on more than 25,000 cases referred to it in connection with the administration of the public lands; and made a decrease of 3,914,000 acres in outstanding government coal reserves, of 110,000 acres in outstanding petroleum reserves, and of 298,000 acres in phosphate reserves. There was, however, a net increase of 268,000 acres in the area classified as phosphate land. The present acreages classified and reserved by the government as coal, petroleum, oil-shale and phosphate lands are: Coal, 65,000,000; petroleum, 6,500,000; oil-shale, 4,100,000; phosphate, 2,700,000. The survey also made a net increase of 635,000 acres in power-site reserves, designated 382,000 acres in Nevada under the ground-water reclamation act, and made net increases of 5,700 acres in public water reserves, of 3,989,000 acres in enlarged-homestead designations, and of 4,778,000 acres in stock-raising homestead designations. The Washington office distributed 602,000 copies of book publications and 695,000 maps, of which 562,000 maps were sold.

The Geological Survey is a scientific bureau which has to do with the mineral resources of the earth rather than with men. Therefore it is known to but comparatively few, for to most people its reports seem to lack human interest. The work of its large topographic force, for instance, is recorded in lines on paper—maps—which do not lend themselves especially well to columns in the newspapers. Where the Geological Survey leaves off others take hold. Thus the geologist may carefully explore and outline on a map the structure of an oil field, and so advise the wildcatter where or where not to drill; yet little public interest attaches to the region until the oil man sets up his rig and begins to drill. So it is with all the work of the organization; it is basic, foundation work, upon which many kinds of development may rest later, after the Geological Survey has moved on to new fields of investigation.

An example of the forward-looking policy of the Geological Survey is seen in its anticipation last winter of the coal strike, when as a measure of preparedness, in cooperation with the census, it made an inventory of the amount of coal stored in the United States, and also prepared and published a map of the United States showing the coal mining districts.

The work of the Geological Survey in connection with oil, says the director, continues to be of increasing value, and the application of geology to practical affairs is shown by the fact that in four oil fields that have been extensively developed the early geologic mapping indicated the existence of oil in the ground, which was later proved by commercial development. Other activities of the Geological Survey included examination of deposits of oil-shale in four states; comprehensive studies of the Colorado and San Juan rivers in Utah and Arizona with reference to reservoir sites; the completion of studies of radium-bearing carnotite ores and tungsten deposits of the United States; the preparation of timely reports on the production of coal and other fuels; making nearly 2,000 detailed analyses of rocks and minerals, and 700 analyses of surface and underground waters; the preparation of special physical and shaded relief maps of Alaska, California, Kentucky and several other areas; continuation of the preparation of the United States portion of the international map of the world, for which maps of 46 states have now been completed and are on sale at nominal prices; the preparation of monthly reports on the production of electricity and consumption of fuel by public utility power plants; and the publication of maps of 14 states showing the location of power sites and transmission lines. These in common with all the 3,000 or more different maps of the Geological Survey are for sale at nominal prices.

SCIENTIFIC EVENTS

VITAL STATISTICS OF PRUSSIA BEFORE AND AFTER THE WAR[1]

THE Prussian Statistical Department issued last year the second part of Vol. 10 of *Medizinalstatistische Nachrichten.* It is a comparative study of the last complete pre-war and the first complete post-war year (1913 and 1919). Prussia is closely comparable with England and Wales in population, and as it has been exposed to different wartime and post-wartime conditions, it is interesting to compare the results. The estimated population of Prussia in 1913 at all ages was 20,596,269 males and 21,052,793 females. In the first completed post-war year (1919) the census showed a decrease in the males to 18,816,849 and females to 20,523,598. The mean age of males in 1913 was 26.6 years, and 28.7 in 1919. There was very little change in infant mortality, the death rate per 1,000 births in the first month of life being 48.7 for 1913 and 48.3 for 1919. The births numbered 1,209,385 in 1913 and 827,335 in 1919, giving rates of 29.0 and 21.0 per 1,000 living. In England and Wales the birth rates were 23.9 per 1,000 living in 1913 and 18.5 in 1919, and the death rates in the first month of life were 44.39 and 44.49 per 1,000 births. In both countries there was an increase in the deaths in childbed, but the third wave of the great pandemic of influenza in 1919 may be assumed to account for some increase. In Prussia the decline in infantile diarrhœa was considerable; the mortality under 1 year was 134.6 per 10,000 live births in 1913 and 44.55 in 1919. Excluding typhoid fever and influenza, the infectious diseases showed a decrease. The number of deaths from scarlet fever in 1919 was less than half that of 1913, being 2,213 against 4,506. In England and Wales 2,100 deaths were registered in 1913 and 1,221 in 1919. The deaths from measles showed a greater decline, from 7,286 to 1,270. The figures for England and Wales were 10,673 and 3,563. There was little change in the deaths from diphtheria and croup, the actual deaths being 7,550 and 7,054, and the rates of mortality at ages up to 15 were 5.42 in 1919 and 5.20 in 1913 (mortality per 10,000 living). The figures for England and Wales were 4,494 for 1913 and 4,916 for 1919, and the rates of mortality under 15 years 3.84 and 4.36 per 10,000. In Prussia the death rates from typhoid fever increased from 0.34 to 0.74 (actual deaths being 1,433 and 2,911). There was a decline in the figures for England and Wales from 1,505 to 577 (0.41 to 0.16 per 10,000). The greatest increase in the causes of deaths was under the head of tuberculosis. The totals were 56,861 in 1913 and 85,996 in 1919, and the crude rate per 10,000 increased from 13.65 to 21.86. The rates for urban districts increased from 15.81 to 27.16 and the rural from 11.65 to 16.84. In England and Wales the total deaths were 49,464 in 1913 and 46,310 in 1919. "The special characteristic of the mortality from tuberculosis in the years under consideration and that which gives rise to the greatest anxiety is the increase of mortality at young ages. Despite the end of the war, the partial improvement of feeding, clothing and heating, normal facilities for medical treatment, and above all the declining birth rate, which would give reason to suppose that more and better attention under the more favorable external conditions of a smaller family would lead to a decline of the death rate, the number of deaths has not in fact declined but increased, a result which is doubtless to be attributed to the aftermath of the hunger blockade." The statistics of pneumonia and influenza show the effect of the great pandemic in 1919. The deaths from influenza were 1,592 in 1913 and 29,141 in 1919. In England and Wales the figures were 6,387 in 1913 and 44,789 in 1919, but the two sets of figures are not comparable owing to the differences in tabulation. The total mortality from influenza and pneumonia was 53,094 and 85,990 in 1913 and 1919, and the corresponding figures for England and Wales were 44,002 and 83,909. The cancer rate shows very little change, 10.13 in 1913 and 10.03 in 1919 for 10,000 persons at ages 30 to 60, and for persons over 60, 54.16 and 51.14. In 1920 the rate increased to 10.22 (ages 30 to 60), and 55.05 (60 and over), the latter being the highest yet recorded.

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[1] *The British Medical Journal.*

THE AMERICAN SCHOOL IN FRANCE OF PREHISTORIC STUDIES

For the year's work from July 1, 1922, to July 1, 1923, three scholarships were offered of five thousand, three thousand and two thousand francs,. respectively. There were over fifteen applicants representing nearly as many states of the Union. The successful applicants are Miss E. L. Bayles, Smith College 1921, of Cincinnati; Mr. Noguera, formerly at Harvard University, of Mexico City, and Mr. J. H. Goff, Oglethorpe University 1920, of Macon, Georgia. Besides these three, three other students completed the summer's work, and one more spent a month in study in the field.

The work consisted in excavation at the station of La Quina in the forenoon, and in attendance at lectures in the laboratory of Dr. Henri Martin, near by, in the afternoon: of these, one was given by Dr. Martin, who accepted a position on the staff as lecturer in paleontology, and a second by the director on prehistoric archeology in general.

The results of the excavations themselves may be said to be satisfactory. The trench continued in 1921 under Director MacCurdy, was extended and proved of somewhat varying richness. The specimens found were predominantly Mousterian, but Acheulean tendencies were not lacking, nor were those of Aurignacian quality (in the upper part). In addition, a small grotto was excavated to a distance of eight meters; the somewhat scanty (though interesting) specimens found here proved almost exclusively Aurignacian. Animal bones, particularly those of the horse, bison and reindeer, were abundant and (as is usually the case) a large number of teeth were preserved.

Excursions were made to Les Eyzies, Teyjat, a neighboring Merovingian cemetery, etc., and at the end of September the students undertook an excursion to the caves of Gargas, Mas d'Azil, Tuc d'Audubert and Trois Frères in the Pyrenean region.

The winter's work is undertaken by the three scholarship holders and the others: the latter hope to remain in Paris as long as possible.

The school would not have existed had it not been for the generosity and kindness of Dr. Henri Martin and his family. In encouragement, scientific assistance and in hospitality they have added one more season of incomparable enthusiasm; the director and the students are deeply appreciative of this, as well as of the kindness of M. Hubert of the Museum of Saint Germain, and of Mr. Passemard, of Biarritz, who generously delivered lectures before the school on the Neolithic, Bronze and Iron Ages and on the Cavern of Isturitz.

Charles Peabody, *Director*

THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

The National Association of Audubon Societies, of which T. Gilbert Pearson is president, is making an appeal for funds for a permanent home. Founded in 1901, the association today is the largest membership organization in the world having for its object the study and protection of wild birds and wild animals.

The association feels that its usefulness could be greatly augmented and the influence of the Audubon Societies of America largely increased, both in this country and abroad, if the headquarters could be installed in a building adequate to its needs, a building providing suitable accommodations for a library of conservation and natural history, photographic exhibits, a museum of conservation, for displaying apparatus for attracting birds and for an assembly hall.

Adequate space is needed to house the library of ornithology and general natural history, as well as various phases of conservation of wild life, which has passed the twelve hundred mark and is constantly growing. Much rare and unreplaceable data dealing with the conservation of wild birds and animals is included, which should be stored in a fireproof building where it may be accessible to the students of to-day and those of the future. At present almost half of the library is in boxes in storage warehouses because of lack of space.

A demand exists for specific knowledge regarding bird sanctuaries and reservations on public lands as well as private estates. It is also believed that the public would be interested in the association's collection of punt-guns, traps, snares, nets and other illegal devices used in taking wild birds, as well as in the various species of birds which are now or have been extensively used in the millinery feather trade. Quantities of these seized from dealers by the state and federal authorities are in the hands of the association.

Besides the library of conservation, the museum and the exhibition hall, the need is felt for an assembly hall where teachers and others interested in bird study might attend lectures and meetings. Additional office space and more storage room are also needed.

LECTURES AT YALE UNIVERSITY ON MENTAL HYGIENE

Under the auspices of the department of social and political science of Yale University and the New Haven Council of Social Agencies, a course of eight lectures on the "Social aspects of mental hygiene" will be given by a group of specialists who have attained prominence in the mental hygiene movement. The movement was started in New Haven in 1908 by Clifford W. Beers, who organized at that time the Connecticut Society for Mental Hygiene. From the beginning the university has sponsored his work and a number of Yale professors have been identified with it.

This course represents an attempt to meet the need expressed by social workers and others for instruction in the field of mental hygiene. The adjustment of human relationships, which is the main object of all social work, calls for knowledge of personality and its development, and an understanding of the relation of mental disorder and mental defect to dependency, delinquency and general social maladjustment. The course is also designed to be of assistance to parents, teachers and others in the community who desire a clearer and more practical understanding of the intricate mechanism of human behavior.

President Angell will act as chairman of the first lecture, which Mr. Beers will give. Dr. O. G. Wiedman, medical director of the Connecticut Society for Mental Hygiene, will preside at four of the lectures, and Dr. Paul

Waterman, chairman of the State Psychopathic Hospital Commission, at the last three.

The following subjects will be discussed: "The mental hygiene movement," Mr. Beers; "The mechanism of human behavior," Dr. Frankwood E. Williams, medical director of the National Committee for Mental Hygiene and editor of the *Mental Hygiene Quarterly;* "Mental hygiene and personal health," Dr. Thomas W. Salmon, of the Rockefeller Foundation; "Mental hygiene and education," Dr. C. Macfie Campbell, director of the Boston Psychopathic Hospital; "Mental hygiene and family life," Dr. Abraham Myerson, assistant professor of neurology at Tufts College; "Mental hygiene service for children," Dr. Arnold Gesell, professor of child hygiene, Yale University, and director of the University Psycho-Clinic; "The feeble-minded in the community," Dr. Walter E. Fernald, superintendent of the Massachusetts School for the Feebleminded; "Mental hygiene in social work," Dr. Jessie Taft, director of the Department of Child Study of the Children's Aid Society and Children's Bureau, Philadelphia.

SCIENTIFIC NOTES AND NEWS

DR. JOHN TROWBRIDGE, Rumford professor emeritus at Harvard University, died at Cambridge on February 18 in his eightieth year.

DR. JOHN DOW FISHER GILCHRIST, professor of zoology in the South African College at Capetown, has been elected president of the South African Association for the Advancement of Science for the meeting to be held at Bloemfontein in July.

MARSTON T. BOGERT, professor of organic chemistry, represented the National Academy of Sciences at the Benjamin Franklin Celebration in Park Row, New York City, on January 17. In the name of the academy, he presented a floral tribute in the form of a lightning flash, bearing the initials of the National Academy of Sciences and "symbolizing both Franklin's harnessing of the lightning and the brilliance of his scientific genius."

DR. DAWSON TURNER and Mr. D. M. R. Crombie have each been awarded a Makdougall-Brisbane medal by the Royal Scottish Society of Arts for their paper on "An investigation of the ionized atmosphere around flames by means of an electrified pith ball."

DR. WILLIAM HOSKINS, of Chicago, consulting chemist, has been elected a director of the American Chemical Society.

THE South Africa medal and grant have been awarded to Dr. I. B. Pole Evans for his contributions to botanical science in South Africa.

PROFESSOR F. C. NEWCOMBE, instructor in botany in the University of Michigan for the last 33 years, and for the last 20 years head of the department, having reached the retiring age, has resigned his position and will leave the university at the end of the present academic year. Professor H. H. Bartlett has been elected chairman of the department.

DR. ANDERS SVEN HEDIN, of Stockholm, who spent thirteen years exploring Thibet and Eastern Turkestan, arrived in New York on February 13 on the Hamburg-American liner *Hansa.* He will lecture and will also visit American Indian ruins.

ARRIVING in Berkeley on February 8, Dr. A. Sommerfeld, professor of mathematical physics in the University of Munich, was for two weeks a guest of the department of physics of the University of California. He delivered a largely attended course of eight lectures on atomic structure and theories of radiation to the graduate students of that and related departments.

THE Clinical Congress of the American College of Surgeons, representing thirty-five states, is making a 14,000 mile cruise to South America, including Brazil, Uruguay, Chili and the Argentine. The party is composed of five hundred persons, including one hundred and sixteen American and Canadian surgeons and their families. The cruise, which will last two months, was arranged by Dr. Franklin H. Martin, of Chicago, and Dr. William J. Mayo, of Rochester, Minn.

DR. JAMES F. KEMP, professor of geology at Columbia University, will go to Porto Rico late in February to make a survey of the mineral resources of the island for the New York Academy of Sciences. He will also assist in a reconnaissance of the Virgin Islands preparatory to detailed geological investigations. Dr. Nathaniel L. Britton, director in chief of the New York Botanical Garden, sailed from New

York with Mrs. Britton on January 20 to prosecute their investigation of the flora of Porto Rico. The work is partly in press now and when completed will be published by the New York Academy of Sciences. Dr. Fred J. Seaver, also of the Botanical Garden staff, accompanied Dr. and Mrs. Britton at the special request of the Porto Rican government. He will make an intensive study of the fungi of the island from an economic aspect, and will return with the rest of the party on April 5.

Among grants made, as we learn from *Nature*, from the Bonaparte fund of the Paris Academy are: 2,000 francs to Wilfred Kilian to assist the publication of a geological bibliography of the south-east of France; 5,000 francs to Emmanuel de Margerie, for the preparation of the publication of a tectonic map of Eurasia; 15,000 francs to Jean Mascart, for the publication of a part of the astronomical work of Luizet; 3,000 francs to M. Mugnier-Serand for his researches on atmospherics in wireless telegraphy and their application to the prediction of storms; 15,000 francs to the Academy of Sciences for the publication of the catalogue of scientific periodicals in Paris libraries.

From the Loutreuil fund of the Academy 5,000 francs have been given to the Association lyonnaise for excavations in the prehistoric deposits of Solutré, and 2,000 francs to Charles Le Morvan for the publication of a map of the moon.

At the annual general meeting of the British Association of Economic Biologists, held on Friday, January 26, the following officers and council were elected for the year 1923: *President,* Professor E. B. Poulton, F. R. S.; *Treasurer,* Dr. A. D. Imms; *Secretaries,* General and Botanical, Dr. W. B. Brierley; Zoological, Dr. J. Waterston; *Editors,* Botany, Dr. W. B. Brierley; Zoology, Mr. D. Ward Cutler; *Council,* Dr. W. F. Bewley, Professor V. H. Blackman, F.R.S., Mr. F. T. Brooks, Mr. A. B. Bruce, Dr. E. J. Butler, C.I.E., Dr. J. W. Munro, Sir John Russel, F.R.S., Professor J. H. Priestley, D.S.O., Professor J. H. Ashworth, F.R.S., Dr. T. Goodey, Mr. A. D. Cotton, Mr. W. E. Hiley. Professor V. H. Blackman and Sir John Russel were appointed vice-presidents.

Dr. Charles Greeley Abbot, of the Smithsonian Institution, will speak before the Syracuse Astronomical Society on March 2, at 8 o'clock. Before the lecture there will be a dinner in honor of Dr. Abbot.

Professor E. V. McCollum, of the Johns Hopkins University, addressed the Public Health Association of Rochester and the Rochester Section of the American Chemical Society on February 2 on "Diet and health."

Dr. A. J. McLaughlin, surgeon of the United States Public Health Service, former commissioner of public health of Massachusetts, addressed the annual meeting of the Boston Health League at the Twentieth Century Club on February 14 on "The control of communicable diseases."

At the annual general meeting of the British Association of Economic Biologists, held at the Imperial College of Science on January 26, Professor R. T. Leiper, M.D., gave an address on the study of helminthology.

A lecture on "Intersexuality and the determination of sex" was delivered by Professor Goldschmidt, of the University of Berlin, at the University of Liverpool on February 15.

Sir Edward Sharpey Schafer, professor of physiology in the University of Edinburgh, has accepted the invitation of the trustees to be the first Victor Horsley lecturer. The lecture will probably be delivered in the autumn.

Professor Zschokke, of the faculty of zoology in the University of Basle, is lecturing this term at the University of Cambridge on the European fauna.

A program commemorative of the work of Charles Goodyear, who did the original work on the vulcanization of rubber in and near New Haven, will be given by the Rubber Division of the American Chemical Society at the spring meeting. The division plans the erection of a tablet in Goodyear's memory. It also is the announced intention of Dr. Bruni, of Milan, Italy, to be present at the meeting and to present a paper on his late researches on the acceleration of vulcanization.

Carl Paul Goerz, founder and until the time of his death head of the Optische Anstalt C. P. Goerz A. G., of Berlin, died on January 14. Mr. Goerz started in business in 1886 in a single room. The Goerz factories now cover several acres in Berlin-Friedenau and Berlin-Zehlendorf, with branch factories in Cassel, Leipzig and several other places. At the present time there are over three thousand employees, making practically everything required in the photographic and scientific field. Mr. Goerz was sixty-nine years old and remained to the last the active head of these enterprises.

MR. E. W. NELSON, the scientific superintendent of the marine laboratory at the Bay of Nigg near Aberdeen, died on January 17.

THE one hundred and nineteenth meeting of the American Physical Society will be held in Room 301, Fayerweather Hall, Columbia University, New York, on Saturday, February 24, 1923.

THE anniversary meeting of the Royal Anthropological Society was held in London on January 23.

THE Royal Microscopical Society has established a section to deal with the practical use of the microscope in connection with industrial research.

AT the International Exhibition of Photography, Optics and Cinematography, to be held at Turin in May and June next, prizes will be given for various kinds of films—among others, films of scientific subjects.

WE learn from the *Journal of Industrial and Engineering Chemistry* that after conducting exhaustive hearings on the bill to appropriate funds for the recovery of the helium which is constantly going to waste from the natural gas wells of the southwest, the committee on public lands of the House of Representatives has decided that the bill should have gone to the committee on military affairs in the first place. The result is that there is no possibility of passage of the bill at this session.

THE Bermuda Biological Station will be open for research this summer, as usual, for some six weeks or more, beginning early in June. The laboratory is provided with running sea water, the needful glassware and usual reagents, but does not furnish microscopes, dissecting instruments or other personal apparatus. It has accommodations for a limited number of persons who desire to pursue investigations on specific biological topics; but no formal instruction will be given. The facilities of the station are offered free of charge to competent investigators. Special, very low, rates for transportation from New York to Bermuda and return are guaranteed. Persons desiring to take advantage of this opportunity should communicate promptly with the director of the station, who will be glad to furnish additional information as to facilities and expenses. Applicants should state the nature of the investigation proposed, the animals or plants which will be needed in the work, and any special appliances desired, addressing the director, Professor E. L. Mark, Museum of Comparative Zoology, Cambridge 38, Massachusetts.

BETWEEN July 1 and October 1, 1923, there will be no routine teaching of undergraduate students at Stanford University Medical School. During this period properly qualified graduates in medicine and medical students of this and of other schools are invited to participate in medical and surgical work, including specialties, in the capacity of special workers. The workers will be expected to assist in the diagnosis and treatment of patients in the outpatient departments, laboratories and wards. Opportunity to make special studies of clinical and laboratory problems will be offered in certain subjects. The minimum period of attendance will be four weeks. Applications, which should give an outline of the medical experience of the applicant, should be sent to the Dean, Stanford University Medical School, 2398 Sacramento Street, San Francisco, before June 1, 1923. A more detailed statement will be sent on application.

THREE donors have given $6,000,000 to the endowment fund of the New York Public Library—John D. Rockefeller, Jr., $3,000,000; Payne Whitney, $2,000,000; Edward S. Harkness, $1,000,000. Added to the present fund of approximately $15,500,000 the amount will enable the library now to operate its reference department without a deficit and to make up arrears in binding, cataloguing and purchasing, but $500,000 more annually will be necessary to meet the natural development of the library. The number of books consulted annually has increased one hundred per cent. in eleven years, and the annual number of readers 200 per cent., from 400,275 in 1911 to 1,225,778 in 1922. Cost of operation advanced 113 per cent. in the same period.

THE *British Medical Journal* states that the announcement is made from Canada that 2,715 claims have already been received for the prize of $100,000 offered by Lord Atholstan, of Montreal, for the discovery of a cure for cancer; claims have come from forty-one different countries. It is pointed out, however, that claimants must satisfy a recognized medical faculty or leading medical society in his or her own country first that there is some scientific basis to justify the experimental investigation of the professed cure, and that any cases said to have been successfully treated were in fact cases of cancer.

UNIVERSITY AND EDUCATIONAL NOTES

SUBSCRIPTIONS to the Harvard endowment fund reached a total of $13,892,605.29 on January 1, according to figures now made public. Of the sum, $10,910,825.31 had actually been paid in on that date, against a corresponding figure a year earlier of $9,776,706.89.

A BEQUEST of $200,000 for the establishment of a department of clinical surgery has been ordered paid by trustees of the estate of Edward A. W. Hunter to the University of Pennsylvania by Judge Thompson in the orphans' court. The fund awarded the university will establish the "Agnew and Hunter Department of Clinical Surgery" in memory of Drs. D. Hayes Agnew and Charles D. Hunter.

A BILL now pending in the Texas Legislature provides for an appropriation of $200,000 for the establishment of a State College of Technology and Textile Engineering.

J. LEIGHTON STUART, president of Peking University, has announced a contingent gift of $75,000 by the China Medical Board of the Rockefeller Foundation. Mr. Stuart recently arrived in the United States to speak in the interest of a campaign to raise $1,000,000 necessary for the removal of the university from its present temporary quarters to its new site by September, 1924.

DR. WALLACE W. ATWOOD, president of Clark University, who was granted a three-months' leave of absence by the board of trustees to visit Europe, has returned. He visited universities and colleges in Scotland, England, Belgium, Germany, Holland, France and Switzerland. He made engagements with several scholars to occupy the visiting professor's chair in geography at Clark for six months or a year.

E. A. MILLER, formerly field agent for the states relations service, United States Department of Agriculture, who for the past four months has been professor of rural economics and sociology in Oklahoma Agricultural and Mechanical College, has been named director of the Extension Division of the college, succeeding W. A. Conner, whose resignation became effective on January 1.

DR. ROBERT A. LAMBERT, assistant professor of pathology and bacteriology in the Yale University School of Medicine since 1919, is severing his connection with the university to assume the professorship in the department of pathology at São Paulo, Brazil. The chair is filled by an appointee of the Rockefeller Foundation, the professor of pathology being a member of the faculty of the school, and in academic matters to be under the direction of the dean, but appointed in cooperation with the Rockefeller Foundation.

DISCUSSION AND CORRESPONDENCE

RESEARCH IN MARINE BIOLOGY

TO THE EDITOR OF SCIENCE: Under the above heading Professor W. J. Crozier[1] has recently advocated a permanent marine biological laboratory in a tropical or semitropical situation, as a continuation of the work of the Department of Marine Biology, Carnegie Institution, so ably directed by the late A. G. Mayor. Dr. Crozier's letter seems to be a special plea for a subtropical institution. Some of his arguments, however, will not hold water. He says:

> Those whose varied experiences have provided an adequate background for judgment in this matter are unanimous in the conviction that the most suitable locations are to be found on the shores of tropical or semi-tropical seas.

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[1] SCIENCE, December 29, 1922, p. 751.

Supreme variety and abundance of animals, ease of access to them throughout the year, a comparative isolation conducive to their scholarly and productive treatment—these can be found only in the warmer seas.

I am not of course informed as to whose unanimous opinion Dr. Crozier refers, but certainly nothing is more erroneous, without severe qualification, than the statement that supreme variety and abundance of animals with ease of access to them throughout the year can be found *only* in the warmer seas. Omitting possibly certain special Pacific localities, disqualified by distance and difficulty of access, there are few groups of marine animals which are not more abundantly represented on our Pacific coast (south, say, to Point Conception) than in the Bermudan-West Indian region which Dr. Crozier may have in mind as being especially favored. I speak of intertidal and very shallow water species, easily accessible. As a matter of fact the west coast fauna is phenomenally rich, being characterized in many cases by an extraordinary abundance of individuals. No warm waters can, of course, hold a candle to the luxurious marine flora of the Pacific coast.

Visiting biologists at Monterey profess themselves astounded at the wealth of shore life—the multitudes of anemones (of eight or nine species), sea urchins, sea stars, bryozoans, annelids (the largest a yard long and an inch or even more in diameter), flatworms, nemerteans, sipunculids, mollusks (consult Dall's lists), crustacea, compound ascidians. The Asteroid fauna of the west coast of North America is the richest in the world. It would be difficult indeed to offset in a West Indian locality the fifty-odd species of Monterey chitons (the largest upward of fifteen inches long), or the ninety-five species of Monterey hydroids, or the variety and abundance of pagurids. We even have a coral which is as tough as the West Indian are tender! Off shore, especially in summer, pelagic life is rich. The same story is repeated further north, notably in the Puget Sound-Vancouver Island region, very accessible.

One who is thoroughly familiar with our Pacific coast littoral finds the intertidal and shallow-water faunas of such islands as Barbados and Antigua disappointing. I understand, however, that Jamaica is somewhat better favored.

An important consideration, easily overlooked, is that few people can work *efficiently* in the tropics for more than short periods. The climate of the Tortugas, and even of Beaufort, I am informed, is very "trying" in summer. The zone of highest mental efficiency is certainly not tropical. Furthermore, in cold waters it is relatively easy to keep animals alive in aquaria and to rear eggs and larvæ. In tropical waters it is difficult. I am informed that at the Tortugas laboratory this was especially true.

Dr. Crozier rightly deplores the unavoidable fact that "the splendid material possessions of the Woods Hole Laboratory . . . are as good as wasted, so far as research is concerned, during eight or nine months of the year." He further states that "the plain fact of the matter is that the existing American institutions for research in marine biology are either more or less unfortunately situated, with regard to climatic conditions or otherwise, or else overburdened in their potentially productive seasons by the requirements of elementary instruction—necessary work, and I speak of it only with respect; but it is not enough."

In his zeal for warm seas, I fear Dr. Crozier has inadvertently overlooked two modest California institutions—the Scripps Institution for Biological Research at La Jolla, and the Hopkins Marine Station of Stanford University at Monterey Bay, both of which are in operation twelve months each year, and certainly are advantageously situated (each in its somewhat different field) as regards accessibility, climate and materials. Monterey, of course, has much the colder water—a predominantly northern fauna. Dr. Conklin stated in conversation (I write from memory) that he had never seen anywhere richer collecting. Need I mention that the climate is never uncomfortably hot, and that irises bloom in the station grounds at Christmas?

Let us by all means have a permanent laboratory, sponsored by the Carnegie Institution, but not in semitropical regions, nor in extra-territorial waters, where a war might hamper or terminate the work. If we are to go in for efficiency, let the location be chosen frankly on its merits, as regards: (1) abundant, accessible, usable fauna and flora; (2) accessibility of station; (3) climate—on a basis of working efficiency during *entire* year; (4) economy in operation.

Organized research in the tropics for a definite purpose is admirable. All honor to Mayor for the splendid work he so indefatigably directed; but let us not take too easily for granted hasty generalizations concerning the superiority of the tropics or subtropics as a situation for a *permanent* marine biological laboratory. There is a glamour about the tropics which is too frequently dissipated on close acquaintance.

W. K. FISHER

HOPKINS MARINE STATION

THE MOVEMENT OF THE CENTRAL ATLANTIC RIDGE

THE soundings in the Central Atlantic area show the existence of a long ridge, which passes through the Azores and the islands of St. Paul and Tristan da Cunha. This ridge shows a bending-point in the neighborhood of the equator between the island of St. Paul and the Romanche deep.

We have pointed out in some recent publications that many of the transverse fractures which often are found near the bending-points of moving geanticlines are the surface expression of differences in rate of horizontal movement. In moving rows of islands several deep straits between the islands coincide with bending-points.

Transverse faults with a horizontal displacement are sometimes visible and where the epicenters of modern earthquakes are on transverse tectonic lines near the bending-point, similar movements are still going on at the present day.

In regions which are not accessible for direct observation, the comparative tectonic method should be applied. If a submarine ridge has a bending-point, the form of the ridge can be the result of differences in rate of movement of neighboring points in the horizontal projection of the ridge. Where the differences are greatest, epicenters of earthquakes will be numerous and if a submarine ridge shows a maximum of seismicity in the neighborhood of a bending-point, this points to movements with unequal velocity in a horizontal direction. The central Atlantic ridge shows a bending-point near the equator and a zone of high seismicity is found in the neighborhood between the island of St. Paul and the Romanche deep. The deeps in the same neighborhood, which are an abnormal feature for the Atlantic sea-bottom, may be in part of similar origin as the abnormal deep straits near bending-points of rows of islands.

The long ridge of the Central Atlantic area has been explained in several different ways, *f. i.*, as the beginning of a zone of arcuate folding, as the highest parts of a subsided continent, as a ridge of volcanic origin and as the filling of an originally narrow gaping fracture which opened to the present Atlantic Ocean by horizontal movement of continental areas.

The application of the comparative tectonic method points to movements with unequal velocity in a horizontal direction, which may have been going on since a very long time. The present S-shaped ridge may have developed from a simpler form by similar movements as those which characterize the present ridge. Anyhow, those explanations in which the horizontal movements are not taken into consideration do not seem to be applicable.

H. A. BROUWER

DELFT, HOLLAND
JANUARY 10, 1923

THE DEPRECIATION OF THE POUND

TO THE EDITOR OF SCIENCE: Advocates of the metric system will be interested to know that, beginning January 1, 1923, all transactions in grain, meal, bran, potatoes and agricultural seeds in the United Kingdom will be conducted on a price per hundred weight of 112 pounds. This is in conformity with the provisions of the Corn Sales Act of 1921. After December 31, 1922, any contract, bargain, sale or transaction in above named staples will be null and void unless made by weight only and in terms of or by reference to *the hundred weight of 112 pounds*.

Thus a step forward has been taken; but at that only a halting one. The pound is no longer 7,000 grains but only 6,250 grains because a pound now is by law only nine tenths of a pound. Dealers in farm products in Great Britain will still use the short ton and the long ton; but seemingly, the stone, the box, the barrel, the firkin, the dry quart, the small measure, the peck and the bushel have been amortized. Peace to their ashes! The struggle is now on between the long ton, 1,016 kgs., and the short ton, 907 kgs.

But we can not say too much about British deliberation in these weighty matters; for do we not (we readers of Science) buy coal and get 2,000 pounds in a ton; while the coal dealer and the United States government get 240 pounds more on each ton? Can it be that we belong to a privileged class?

Alexander McAdie

CORRECTION

A small but rather serious error occurred in my article, "Note on the fusarium wilt disease of bananas," appearing in Science of December 8, 1922. In lines 14 and 13 from the end, page 664, the word *inoculated* should be *un*inoculated.

Mark Alfred Carleton
Cuyamel, Honduras

QUOTATIONS

THE VIRUS OF INFLUENZA

A recent outbreak of influenza in South Africa afforded to Sir Spencer Lister, the well-known bacteriologist, an opportunity of making some important observations which he describes in the *South African Medical Record* of November, 1922. He recalls that when influenza made its appearance in Johannesburg during the pandemic of 1918, Pfeiffer's bacillus—relatively absent in that community before the outbreak—was found by him in no fewer than 53 out of 56 cases dying with pulmonary complications; but his attempts to detect a filter-passing virus either by experiment or by culture failed. It is the more interesting, therefore, to learn that in this recent outbreak he has succeeded in satisfying himself of the presence of an anerobic filter-passing organism similar to that defined by the careful studies of Olitsky and Gates in New York, and confirmed by Gordon in the London outbreak during the early months of 1922, as reported in our columns on August 19, 1922. By sowing in Noguchi medium the filtered naso-pharyngeal washings taken within thirty-six hours of the onset of influenza Lister succeeded in obtaining a culture of the filter passer in 5 out of 15 cases. He comments on the ease with which the presence of this very minute organism may be overlooked without unusual concentration of gaze and accurate focusing. The stain which he found most successful for demonstrating the presence of the organism in films was Loeffler's alkaline methylene blue, the latter a specimen of Grubler's pre-war stock. The size of the organism was 0.15 of a micron, which is smaller than the organism found by Gordon, who estimated it to be 0.2 of a micron in diameter—a difference probably to be ascribed to the different methods of staining, as the latter observer employed prolonged staining in Giemsa's solution; he has seen preparations of Lister's organism, and agrees that it is identical with that observed by him in films of the nasal secretion and in cultures from the London cases. Lister has taken matters a stage farther than previous investigators by carrying out a preliminary experiment on human volunteers with cultures of this filter-passing organism. Sixty c. cm. of a culture in the second generation were divided into three portions—one third was placed in a spraying bottle, one third passed through a Berkefeld V filter and the filtrate placed in a second bottle, and the remaining third treated for half an hour to 56° C. and placed in a third spraying bottle. Six individuals were then sprayed with the unaltered culture, seven received the filtrate, and six the heated culture, about 1.5 c. cm. being sprayed into the nose and throat of each volunteer. The only one of these nineteen volunteers who complained of any discomfort had received the unaltered culture, and developed a typical attack of uncomplicated influenza beginning nineteen hours after spraying. The minute bodies were observed in smears of his nasal secretion, and a nasal washing was filtered through a Berkefeld candle. This filtrate on cultivation in Noguchi medium gave in five days a profuse growth of the organism. Two other individuals also in this first group that received the unaltered culture had a slight rise of temperature, and one of them showed a well marked leucopenia. Although, as Sir Spencer Lister is careful to point out, this result is not sufficiently conclusive to establish the filter passer as the cause of influenza, it is distinctly encouraging, and further reports of his enterprising investigations will be awaited with interest.—*The British Medical Journal.*

SCIENTIFIC BOOKS

Geology of the Tertiary and Quaternary Periods in the Northwest Part of Peru. By T. O. Bosworth. With an account of the Paleontology by Henry Woods, T. Wayland Vaughan, J. A. Cushman and others. Macmillan & Co., 1922.

This book of 434 pages is devoted to the post-Cretaceous geology of the coastal strip, fifteen to forty miles wide in northern Peru, and extending from Tumbez southward to Payta, a distance of about one hundred and fifty miles. It is made up of five rather distinct and largely uncoordinated parts: (1) Tertiary Geology; (2) Tertiary Paleontology; (3) Quaternary Geology; (4) Desert Geology; (5) Occurrence and Exploitation of Petroleum; all but the second being by the author. The book is a result of several years of professional work in the region and is a most important addition to our knowledge of it.

The geological elements comprise the Andean chain of the Amotape Mountains on the east, consisting of slates, quartzites and granites of Paleozoic and Mesozoic age, and lying west of these mountains the present desert plain made up of Eocene and Miocene, littoral and shallow water formations, and a series of Pleistocene wave cut terraces and beaches or Tablazos. The Oligocene Ovibio formation, the lower Miocene Heath formation, the upper Miocene Talara formation and the Pliocene Payta formation described in this region by Grzybowski and others are shown not to exist.

The Eocene consists of two formations with a total thickness estimated to be more than twelve thousand feet and consisting of clay shales, more or less calcareous sandstones and beach pebbles. The oldest of these, the Negritos formation, is especially rich in gastropods and is divided into an older Turritella series and a younger Clavilithes series. The fauna is shallow water and largely molluscan, but containing a few crustaceans and fish teeth. It shows a marked resemblance to that of the Wilcox and lower Claiborne of our gulf states and is indicative of a seaway between the two regions. Frequent mention is made of the presence of a species of Aturia in the Negritos. The reviewer's collections from that formation contain no Aturia but do contain abundant specimens of a large Hercoglossa.

The Negritos is followed by some five thousand feet of lithologically similar beds constituting the Lobitos formation. The fauna is essentially similar to that of the Negritos but sparser, and contains Foraminifera of several species, notably the genera *Lepidocyclina* and *Orthophragmina,* and is considered to be upper Eocene in age.

The Zorritos formation, which makes up the balance of the Tertiary, is estimated to be about five thousand feet thick and is considered as Miocene in age, although the author seems to be in doubt as to there being any break between it and the Eocene Lobitos formation. The author did little detailed work in the more northern region where the Zorritos is well exposed, consequently but three pelecypods and six gastropods are described from it. In the paleontology of the Zorritos formation published by Spieker[1] before Bosworth's book reached America, there are described forty-four gastropods and fifty-seven pelecypods, and the age was definitely proven to be lower Miocene. Bosworth does not mention the three hundred feet of variegated, partly continental and lignitic Zorritos which is so conspicuous in the Zorritos district.

The Quaternary is represented by a series of four (possibly more) sea-cut terraces, the oldest of which reached inland almost to the Amotape Mountains. These terraces (Tablazos) are named the Mancora, Talara, Lobitos and Salina and record extensive oscillations of level. It seems unfortunate that for the second Bosworth uses a name already used for a supposed Miocene formation in this region, and that for next to the last he uses a name already applied by him to an Eocene formation in the region. These tablazos consist of thin sheets of light colored beds of shell rock, marl, sand, sandstone and conglomerate, very variable laterally, quite fossiliferous, and lying practically horizontally on a plane of marine erosion on the much faulted underlying Tertiary. The pebbles are beach pebbles of volcanic rocks from the western Andes, sub-angular quartzites, slates and granites from the Amotape mountains, and those derived from the underlying Tertiary.

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[1] Spieker, E. M.: *Johns Hopkins Studies in Geology,* No. 3, 1922.

The intense block faulting of the Tertiary preceded the Tablazo period, but there has been subsequent differential warping since the surface of the oldest or Mancora tablazo declines from an elevation of eleven hundred feet at Mancora to two hundred feet at Payta. The younger tablazos are progressively less extensive and less elevated, and the latest or Salina plain has been brought above sea level by a recent uplift of from ten to fifteen feet. The contemporaneous breccia fans bordering the mountains, and river terrace and other deposits are also dealt with. The author is impressed with the vast time involved in the oscillations and consequent events of Quaternary time in this region, amounting, if one may take his remarks on page 259 literally, to some five million years.

Part 4 is devoted to desert conditions and processes and is a most valuable description and discussion of land forms and processes under conditions which are little known to the average geologist. Part 5 is a not altogether satisfying account of the petroleum industry in the region. The chapter on the occurrence of oil in fault blocks, often of small size, is as interesting as it is unusual.

In conclusion the work is a most commendable one and indispensable to any one interested in or contemplating working in the region. As an example of book making there are some features that might have been better done. The five parts into which it is somewhat artificially divided are not coordinated and there is considerable repetition. One questions the wisdom of splitting it up into 76 chapters, some of which are only a paragraph in length, and in a book with one hundred and fifty figures besides many plates the readers might dispense with several views of the author at the plane table, which is a well-known instrument even in Peru. With all due appreciation of this as the first comprehensive work on the region it would seem that previous workers have been given but slight consideration, and in particular the main stratigraphic units do not differ greatly from those of the Cuerpo de Ingenieros de Minas of Peru, which is not mentioned.

The author's insistence on a range of pre-Tertiary desert mountains, which he states were higher in earlier times than they are at present, may well be questioned. Obviously the Andean region underwent changes of level both by uplift and erosion throughout its history and some of its rocks were folded in very ancient times, but I am not prepared to accept the author's conclusions, based on the absence of Eocene deposits elsewhere on the west coast of South America to the southward of this region, the enormous estimated thicknesses of the Eocene, and the presence of Andean pebbles, as proof of a high range, particularly as the fossil plants found in the Zorritos formation[2] show no evidence of desert conditions or of high mountains across the path of the easterly humid trade winds, and the topographic form of the mountains themselves precludes such a conclusion, as does also the paleobotanical evidence of Pleistocene elevation derived mostly from Bolivian localities, but recently discovered as near the region treated by Bosworth as Cajamarca in northern Peru.

Edward W. Berry

The Johns Hopkins University

SPECIAL ARTICLES

THE LOCATION OF ENERGY

A calculation of the mass of an electron, based upon the modification of electromagnetic theory proposed in a recent paper,[1] has led to the surprising result that the mass inside an electron in uniform motion, when calculated from the momentum, is equal but opposite in sign to the mass outside.

Before the calculation was carried to eight decimal places the sum of the two masses appeared to be a small positive multiple k of e/ac^2, where e is the charge of the electron, a its radius and c the velocity of light. The boundary of the electron is supposed to be a sphere of radius a when the electron is stationary.

It was thought at first that this calculation indicated that a must be much smaller than is generally supposed, of the order 10^{-17} cm., for instance, but further consideration has led the writer to the view that the equality of the two masses is exact and that it may be advantageous to regard the mass of the electron as being situated inside the electron rather than outside.

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[2] Berry, E. W.: *U. S. Natl. Mus. Proc.*, Vol. 55, pp. 279-294, 1919.

[1] *Physical Review*, September, 1922.

A few remarks will now be made to make this point of view seem reasonable. It is supposed in the new theory that an electric charge produces both a vector field (the electromagnetic field) and a scalar field which may be specified by means of retarded potentials and which exists both inside and outside the electric charges. The scalar field is derived from a single potential Ψ which reduces to the ordinary electrostatic potential when all the electric charges are stationary but differs from it in general when charges are in motion.

Associated with the two fields there is a tensor T whose components give the densities of energy and momentum and also the fluxes of these quantities. Two tensors T_1 and T_2 were mentioned (in the paper) which would give no radiation of energy and momentum to infinity on the whole when an electron describes a periodic orbit under the influence of an electrostatic field of infinite mass. By slightly modifying the second tensor it is possible to retain the property just mentioned and arrive at the same expression for the body force per unit volume as was obtained from the first tensor, except that there is a difference in sign. This modified form of the second tensor will be called T_2. In addition to these a third type of tensor must be considered.

A state of the ether will be regarded as *chaotic* when there is no flow of energy, no density of momentum and a density of energy which is constant and the same for different standard observers that are moving uniformly relative to one another in various directions. The flow of momentum across a surface is then always normal to the surface and on the whole there is no flow of momentum into or out of a closed surface which is fixed relative to a standard set of axes. The ether thus not only exerts no body force on the ether within the surface, but the surface forces depending on the flow of momentum form a system in equilibrium. The tensor T_0 corresponding to a chaotic state of the ether will be called a *chaotic tensor*, the stress-system represents a constant positive or negative pressure which is equal in magnitude to the density of energy. It is found that the best results are obtained by assuming that the tensor T associated with a system of electric charges is of type $T = T_0 + \frac{3}{8}T_1 - \frac{5}{8}T_2$, where T_0 is a chaotic tensor whose magnitude inside an electron is different from its magnitude outside, the difference being sufficient to make the stress across each surface element of the electron continuous.

In order to retain the Newtonian law of motion in the form, rate of change of the momentum in any region equals the impressed force, it seems advisable to depart from the usual convention of electromagnetic theory and change the signs of the densities of energy and momentum and that of the flow of energy. It may be mentioned that the usual convention was adopted in order to force the energy and mass of an electron to be outside the electron, the result being that the rate of change of the electromagnetic energy inside the electron is represented as being equal to minus the resultant of the body and surface forces. With the assumption, however, that there is no momentum inside, the body force is shown to be equivalent to a surface force which is in accordance with the idea of Maxwell and others that all actions in the ether are really contact or surface actions.

This principle is also adopted in the new theory, but the body force is supposed to vanish in virtue of a set of equations which are assumed to be equivalent to the equations of motion. The new theory must be regarded simply as an experiment, its adoption or rejection must depend entirely upon whether the equations of motion do or do not give results that correspond with the facts.

So far the results seem rather promising. A mathematical reason is found why an electron, which has returned to rest after any type of motion, may have the same size and mass as before. If, moreover, we adopt as a criterion for the possibility of a given steady state of motion the requirement that there should be no radiation of energy to infinity we can say that an electron may apperently describe a circular orbit round a positive nucleus of infinite mass, but two electrons at opposite ends of a diameter could not describe such an orbit because there would be a continual radiation of energy to infinity.

The chief disadvantage of the new theory is that it makes the electromagnetic energy negative and requires that negative electromagnetic energy should be radiated, when an electron is accelerated, to compensate for the positive energy, depending on the scalar potential Ψ, which is radiated in various directions.

The existence of negative energy in the ether may be avoided by adding a chaotic tensor of suitable magnitude, whichever type of energy we regard as positive; the magnitude of this tensor outside the electron is, however, greater when electromagnetic energy is regarded as negative than when it is regarded as positive. This may be regarded as a disadvantage of the convention adopted here, consequently it seems advisable to leave the question of sign open and to assume temporarily that T_0 is zero outside the electrons and positive nuclei. Then, when the question of sign has been decided, a positive chaotic tensor may be added, if necessary, to make the density of energy everywhere positive. When we speak of negative energy we mean simply that its sign is different from that of the energy inside an electron and that it represents a deviation from the chaotic state in which there is a uniform distribution of energy. If we suppose that the present ordered state of the ether has been derived from a chaotic state, then the idea that a surplus of energy in one place is balanced by a deficiency in another seems reasonable. With this supposition, too, the total momentum must be zero, a condition which is satisfied in the case of a single electron if, as we found by calculation, the momentum inside is equal but opposite in sign to the momentum outside. This means that the mass of the electron can be calculated from conditions inside just as well as from conditions outside.

When an electron is moving along a straight line with uniform velocity v the contribution of the chaotic tensor T_0 to its internal energy is proportional to $\sqrt{1-\frac{v^2}{c^2}}$ since the volume is diminished in the ratio $\sqrt{1-\frac{v^2}{c^2}}:1$ on account of the Lorentz-Fitzgerald contraction. The chaotic energy inside the electron, which is greater or less than the normal amount, according to the convention as to sign, may thus be regarded as proportional to $m_0\sqrt{1-\frac{v^2}{c^2}}$ where m_0 is the stationary mass. Now this is just the type of expression that occurs in the form of Hamilton's principle that has become so important in the modern theory of relativity, consequently the assumption of a chaotic tensor may be necessary for a physical interpretation of the Principal of Least Action.

The idea that the electromagnetic energy in a wave of light is negative may seem strange and contrary to the fact that light exerts a pressure, but it should be remarked that in our opinion the energy in a wave of light is really positive and depends for its positive quality on the disturbance specified by the retarded potential Ψ. So long as there is positive energy on the whole and a flow of positive energy in the direction of the waves there will be a pressure proportional to the density of energy.

In conclusion it may be remarked that the tensor, T, for an electron has been chosen so that in the state of uniform motion the mass, m, and total internal energy, E, are connected by Einstein's relation, $E = mc^2$.

The constant k in the expression for the mass appears to be $1/16\pi$ but it is not certain that this is the value which is actually measured, for, judging from a rough calculation, the total force exerted on an electron by the scalar and vector fields is, in a simple case at least, three times the ordinary electromagnetic force, the force exerted by the scalar field being twice as big as that exerted by the electromagnetic field. It should be remarked that both the total energy and the electromagnetic energy can be regarded as positive if an additional tensor is introduced for the interior of an electron and the usual convention of signs adopted. The value of k is then $\frac{1}{2\pi}$.

H. BATEMAN

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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Secretary, W. D. Harkins, University of Chicago, Chicago, Ill.

(Report by W. D. Harkins)

The general opinion expressed by the chemists in attendance at the Boston meeting was that the program gave an extremely interesting and important summary of progress in this science, particularly with reference to a number of topics which are of great interest to other scientists and to the public.

The four principal topics considered were atomic structure, photochemistry and photochemical synthesis, colloids and colloidal behavior, and the ionization of salts in solution. In addition the chemists were invited to attend a symposium arranged by the physics section, upon a subject of extreme importance to chemistry, that of ionization potentials and atomic radiation.

Symposium on Atomic Structure

One of the most interesting subjects presented at the symposium on atomic structure was that of the size of atoms, especially as they exist in solids. Only a few years ago it was believed that the atoms in solids occupy only one fourth to one half the total volume at any instant, but that each atom vibrates with a high frequency in the space between the adjacent atoms available for this purpose. It was supposed that in the compression of the solid the atoms are merely forced closer together, without any distortion of the atoms themselves. About fifteen years ago Professor T. W. Richards of Harvard University began to develop the distinctly novel idea that the atoms occupy most of the space in a solid and that in any considerable decrease of volume the atoms themselves are diminished in size. This gave rise to his celebrated theory of "compressible atoms." In 1921 Professor Richards showed that the dimensions of atoms could be calculated from the compressibilities of the solids in which they exist, provided data are available for a set of compounds related to each other chemically in a sufficiently simple way. For example, he obtained such data for the fluorides, chlorides, bromides and iodides of lithium, sodium, potassium, rubidium and caesium. Using an ingenious extrapolation to zero compressibility he was able to show that the values correspond to a diameter of 2.8 Ångstrom units (ten-millionths of a millimeter) for the chlorine atom in common salt and other similar compounds. The interesting feature of the results is that the diameters of the atoms, especially those of the metals, proved to vary with the nature of the compound in which they are found. Thus the sodium atom is smaller when combined with chlorine (as it is in common salt) for which it has a high affinity, than when it is united to bromine or iodine for which its affinity is less. Professor Richards's most recent work, as described in his paper, has been to devise a new and more directly experimental method for calculating the dimensions of atoms, with the remarkable result that the values obtained are the same, within the limits of error, as those given by the older method. The new method depends upon the idea that the element sodium acts under compression exactly as potassium would act under high pressure. The attractive forces between the atoms is such that the internal pressure in sodium under ordinary conditions is 20,000 atmospheres higher than that in potassium. By using the data on these two elements, he is able to show how the contraction which occurs in the formation of a salt from the elements may be distributed between them. The results throw much light upon the mechanism of chemical combination, the magnitude of the internal pressures involved and many allied phenomena.

It is found that the contraction which occurs in the formation of a salt from the elements involved is of the order of magnitude to be expected from a consideration of the compressibilities and the internal pressures believed to exist in them. The fact that the thus computed order of magnitude of the compressibility of the salt is the same as that of the actual compressibility determined by measurement, seems to show conclusively that the internal pressure is the cause which determines the volumes of liquids and solids.

A closely related topic, that of the changes of volume which occur in the formation of solid salts from the elements which constitute them, and the further volume changes when these salts are dissolved in water, was discussed by Professor Gregory P. Baxter, of Harvard University. It is well known that his results are the most accurate of those obtained in this field, and they have been used as the basis of a number of interesting volume relations developed recently in connection with the development of the Born and Landé theory of atomic structure. Professor Baxter demonstrated that the changes of volume which occur either in ordinary chemical combination or in the process of solution are the result of several factors, the compressibility of the material and the chemical affinity being the principal properties involved. It was found that the volume of salt in a solution is an additive property of the volumes of the ions which constitute it even in concentrated solutions (up to 5 normal) and at all temperatures. This is of importance in connection with the application of the theory of electrolytic dissociation.

An interesting and important paper on the relation between X-rays and atomic structure, and on the application of X-rays in the determination of crystal structure, was presented by Professor William Duane of Harvard, the leading American authority upon this subject. He showed in a simple way the relations exhibited between the emission and absorption of X-rays and the structure of the atoms as interpreted in the light of the quantum theory. Two kinds of X-radiation have been discovered: The general or continuous spectrum, and the characteristic X-ray spectrum. The wave lengths of the latter depend upon the atomic number of the chemical element used as a target in the X-ray tube, while the former contains all wave lengths down to a well-defined minimum, the value of which depends upon the difference in potential (V) applied to the X-ray tube. The relationship supposed to hold in this connection is the quantum relation of Planck as expressed by the equation of Einstein:

$$Ve = h\nu = h\frac{c}{\lambda}$$

in which e is the charge on the electron, ν is the frequency of the radiation, λ is its wave length, and h is the quantum constant.

In 1914 Professor Duane tested this quantum law, using the limit of the general radiation, and found that it holds with great exactness, so that this method gives one of the most precise methods for the determination of the value of the quantum constant (h). This equation has recently been used by Clark and Duane as the theoretical basis of the most precise method yet devised for determining the distance between the atomic planes in a crystal, in which case the equation is most simply applied in the form:

$$V\lambda = h\frac{c}{e} = 12{,}354$$

in which V is in volts and λ in Ångstroms.

In the experiments the crystal is so set that the X-rays reflected by the planes whose distance apart it is desired to measure enter an ionization chamber filled with ethyl bromide vapor. The voltage is then reduced gradually, and at a certain definite voltage it is found that the ionization in the chamber disappears. This is the voltage corresponding to the limit of the general radiation described above. The distance d between the atomic planes is obtained by the use of the general equation for a grating,

$$d = \frac{n\lambda}{2\sin\theta} = \frac{12{,}354}{2V\sin\theta}$$

in which n is a whole number and θ is the angle corresponding to the proper peak in the ionization current diagram obtained by rotating the crystal. In the case of potassium iodide this was found to be 3.534 Ångstrom units, which corresponds almost exactly to the density of the same salt as determined by Baxter.

Dr. George L. Clark, of the same laboratory, discussed the application of this method to the determination of the crystal structure of caesium tri-iodide. This work is remarkable in that it represents the first successful attempt to determine the structure of a rhombic crystal, all crystal structures heretofore investigated being of a simpler type. It is found that the atoms of caesium lie at the corners of a rhombohedron, and that diagonally across this solid figure three iodine atoms are distributed in such a way as to divide the distance equally between them. The completion of this work, together with the determination of the structure of potassium tri-iodide, marks an important step in the study of the structure of complex inorganic compounds. The most interesting feature of the experimental work on caesium tri-iodide is the discovery of a method of fixing the positions of atoms of different elements which have practically the same atomic weight, as is the case with caesium and iodine. This was done by causing each atom to register its own spectrum.

The University of Chicago was represented by two general papers, one on ionization and resonance potentials and their importance to chemistry, by W. Albert Noyes, Jr., and the other on the separation of isotopes, particularly as carried out in the Chicago laboratory, by R. S. Mulliken. In addition to a general treatment of his subject Dr. Noyes discussed the idea of Gibson and Noyes that in most cases the potential required to produce luminosity in a gas, when a heated cathode is used, is an integral multiple of the ionization potential. At the request of the chairman, and in answer to numerous questions from the floor, Dr. Irving Langmuir discussed this paper at some length.

Dr. Mulliken showed very clearly that many of the methods proposed for the separation of an element into different types of atoms or "isotopes" have failed thus far. All of the methods which have proved successful may be classified under the one term "diffusion methods," whether the diffusion takes place through a membrane as in the experiments of Harkins and his collaborators, Broeker, Hayes and Liggett, using chlorine in the form of hydrogen chloride, or through the surface used as a membrane, as in the work of Broensted and Hevesy, Mulliken and Harkins, and Harkins and Madorsky, in which mercury has been separated by vaporization at low pressures. Dr. Mulliken described a very rapid apparatus which he has recently constructed, in which mercury, separated to some extent by vaporization, is further separated by diffusion of the vapor through a membrane of filter paper. The centrifugal method, which has thus far failed, seems to give promise of becoming the most rapid of all methods thus far proposed, provided the structural problems of the centrifuge are properly solved. Dr. Langmuir suggests that Hertz has devised a method of applying the diffusion method which might lead to a rapid separation, but a later consideration of this method by Dr. Mulliken seems to indicate that the method is unlikely to show any marked superiority over other diffusion methods, and *may* be decidedly inferior.

Professor Kraus, of Clark University, gave a valuable review of his extensive work upon the characteristics of the metals, salts and non-metals, or of metals, electrolytes and non-electrolytes. Professor Kraus has made extensive studies of the behavior of substances when dissolved in solvents other than water, such as ammonia, sulphur dioxide, etc. He has been able to show that a substance which is usually considered as a metal, such as sodium, may act as a salt when dissolved in the proper solvent. Thus this is the case when sodium is dissolved in liquid ammonia.

Professor Kraus presented a new classification of substances in four groups, as follows: (1) Electrolytes, which conduct even in the pure state; (2) non-electrolytes, which conduct neither when pure nor when in solution; (3) meso-electrolytes, which show a slight conducting power both in solution and when pure; (4) pseudo-electrolytes (like the acids), which are non-conductors when pure, but ionize in solution because they combine with the solvent.

The address of the retiring vice-president of the section was on the subject of atomic structure and the general periodic system of the isotopes,[1] and will be published in a later issue of SCIENCE. Many interesting photographs of the tracks of helium atoms (α-particles) in gases, as obtained by R. W. Ryan and the speaker, were exhibited.

Colloids

One of the features of the meeting was an illustrated address on "Proteins and the theory of colloidal behavior," in which Dr. Jacques Loeb, of the Rockefeller Institute for Medical Research outlined the theory presented in his recent book of the same title. He discards the older idea that the swelling of protein gels is due to the preferential absorption of certain ions, notably of hydrogen and hydroxyl, since his experiments indicate that proteins behave as definite chemical compounds of an amphoteric nature, that is, in the presence of acids they act as bases, and in the presence of bases they act as acids. Dr. Loeb considers that the erroneous older view has held sway so long only on account of the general failure to measure the hydrogen ion concentration of the solutions used in the investigations.

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[1] See a paper entitled "The Stability of Atom Nuclei, the Separation of Isotopes, and the Whole Number Rule," by William D. Harkins, *J. Franklin Institute*, Vol. 194, August to December (1922), and Vol. 195, January to March (1923).

It is concluded that the basis of colloidal behavior is to be found in Donnan's theory (1910) of membrane equilibria. Donnan found that when a membrane separates two solutions of electrolytes, one of which contains an ion which cannot diffuse through the membrane which is penetrable to the other ions, the result will be an unequal distribution of the diffusible ions on the opposite sides of the membrane. Thus if there is a solution of NaR (where R^- is the ion which does not pass through the membrane) on one side, and NaCl on the other of the membrane represented by the vertical line below

$$\begin{array}{r|l} Na^+ & Na^+ \\ R^- & Cl^- \end{array}$$

there will follow a diffusion of NaCl from left to right as represented below

$$\begin{array}{r|l} Na^+ & Na^+ \\ R^- & \\ Cl^- & Cl^- \end{array}$$

until the product of the concentrations of the sodium and chlorine ions on the right becomes as great as the similar product on the left, which represents the attainment of a state of equilibrium. This reminds the reviewer of very similar relations worked out even earlier by Haber (in 1909). In any event, Dr. Loeb makes a very strong case for the importance of this relation in the interpretation of the action of proteins. He considers that the famous Hofmeister series of ions has been obtained on the basis of erroneous reasoning.

The chemistry of the photographic process was discussed in an illustrated address by Dr. C. E. K. Mees of the Eastman Kodak Company, who described the methods of investigation in use in the laboratories of his own company and in those of various European investigators.[2] One of the most interesting of the recent results is concerned with the application of the quantum theory to the theory of development of the photographic plate. The silver chloride in a photographic plate exists as small crystals belonging to the regular system and imbedded in the gelatin. Each of these crystals is commonly called a grain. These grains often gather into clumps, which tend to develop together, so that there seems to be a process of "infection." In the early applications of the quantum theory it was considered that one quantum of energy should make a single grain developable, but it has recently been demonstrated in the laboratories of the Eastman Kodak Company that it is necessary to supply several hundred quanta per grain. It is found that a grain may be more or less exposed, and that the development depends upon the reduction potential of the developer which is used. Dr. Mees showed that if the number of grains developed per 1,000 grains present is plotted on the Y-axis, and the wave lengths of the light used upon the X-axis, a Gaussian type of curve is obtained in the case of par-speed portrait film, and a very different type of curve when standard slow speed lantern slides are used, at least for the wave lengths so far investigated.

Ionization of Salts in Solution

Much interest was excited by the program of the symposium on the ionization of salts in solution, in which Dr. D. A. MacInnes of the Massachusetts Institute of Technology presented the argument for the newer theory, which is that strong electrolytes are practically 100 per cent. ionized in aqueous solutions, and in other solvents similar to water. The viewpoint of the classical or Arrhenius theory was to have been presented by Dr. James Kendall of Columbia University, but on account of a severe New England snow storm he did not arrive until shortly after the meeting was over. This made it necessary for Dr. MacInnes to present both sides of the question, which he did very ably.[3] The subject was discussed by W. Lash Miller, Charles A. Kraus, E. W. Washburn, W. D. Harkins, and a few others whose names were not recorded. There seemed to be a general agreement that the general question at issue is not at all the relative value of the newer theory as opposed to the original form of the Arrhenius theory, but rather its merits in contrast to those of the most recent form of the classical theory. Thus practically all of the upholders of the classical theory no longer think of the existence of molecules of sodium chloride (NaCl) as such in an aqueous solution, but they assume that *at any instant* a part of the salt is less ionized than the rest in the sense that the ions of opposite charge are closer together, and are therefore less independent as carriers of the current. Unfortunately, from the standpoint of a clear presentation of the subject, the meaning of the term "ionized" has been entirely changed in later years by its use in a different sense from the original one by workers in physics. It is now customary to say that in solid sodium chloride there is complete ionization, and the upholders of the classical theory of ionization in solution have always assumed that the ionization in aqueous solution is more marked than in the solid state. It therefore becomes necessary to devise another term to replace the word ionization. Several years ago it was suggested that the term "electrolytic dissociation" might well be used in all discussions of the theory in place of the word "ionization."

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[2] See "Recent Advances in Photographic Theory," by C. E. K. Mees, *J. Franklin Inst.*, 195, 1-21 (1923).

[3] It is hoped that the paper of Dr. MacInnes may be secured for publication in a later issue, so what is presented here represents the point of view of the discussion rather than that of his paper.

On the whole the impression gained from the meeting was that the upholders of the two theories have the same ideas, but talk about them in different words. However, it would seem that in so far as the 100 per cent. theory assumes independent migration of the ions, and the independent influences of the ions in connection with solubility effects, it is in error, since these assumptions are contrary to the facts as represented in the work of Braley on the transference of sodium in a 0.01 normal sodium chloride with 0.1 normal potassium chloride present. In this case the sodium is not transferred at all, which is a result wholly unexpected from the point of view of the 100 per cent. theory. The solubility relations of salts of the type of calcium and magnesium sulphates also give evidence of the formation of complexes.

The principal support for the 100 per cent. theory lies in the additive nature of the properties of salt solutions, but this is a fact well known to the upholders of the older theory. One of the principal arguments of the newer theory is based upon the fact that the thermodynamic potential or the activity of the salt in solution varies in quite a different way from the conductivity ratio. No one at the meeting seemed to defend the present values of the percentage dissociation listed in text-books, such as the value 86 per cent. given for potassium chloride at 0.1 normal concentration. Thus the value of the newer idea may be that it indicates that the classical theory has been expressed in too dogmatic a way. What seems to be most needed in connection with this subject is a new terminology. It is probable that ion aggregates of the type $Cl^-Na^+Cl^-$ exist, at least for a very minute interval of time, in aqueous solutions. These were formerly designated as "intermediate ions" since the term complex ions, better in many respects, was reserved by custom for more stable aggregates. If it is to be assumed that these aggregates are completely ionized it would seem that the term "ion aggregate" would serve as well as any other. The new theory seems to give its greatest promise along the line partly developed by Milner—that of working out the general kinetic theory of electrolytic solutions on the basis that the ions preserve their charges, but that they unite more or less with ions of the opposite charge to form aggregates which are less affected in their motion by the applied potential. It is apparent that much of the work now appearing in support of the newer theory is related specifically to neither theory, since it simply involves the finding of equations containing enough constants to enable them to represent the facts. While this is a very valuable method of progress, it is well known that such equations can be developed in the case of almost any type of related phenomena, so the existence of such equations is not evidence in favor of any specific theory until it is shown that the theory is a necessary basis for the equations. The above discussion of the symposium on ionization does not properly represent the discussions presented, since they embodied a great deal of detail, but it represents simply one view of the situation as suggested to the mind of the individual asked to report on the present status of the theories as brought out by the symposium.

Work of the Fixed Nitrogen Laboratory

In an illustrated address on the above subject Dr. F. G. Cottrell, director of the laboratory, discussed in detail the practical and the research methods used in the fixation of nitrogen. So much valuable information was presented that it is impossible to do the subject justice in the space which is available. It was pointed out that catalyzers for such a reaction as the formation of ammonia from nitrogen and hydrogen differ greatly in their relative effectiveness at different temperatures, so that the choice of the proper catalyzer is very difficult. An effective catalyzer must not only take up nitrogen and hydrogen easily, but it must also not hold too strongly to the ammonia which is formed. Many of the most active catalyzers adsorb impurities readily, and thus become much less active than those which are as poor at the start as they ever will be, which is the case with magnetite. The present tendency is to use very dense fused oxides to form the catalyzer. On reduction sufficient porosity is gained. The present tendency in this process is toward higher pressures.

International Critical Tables

Dr. E. W. Washburn, editor of the "International Critical Tables," pointed out that the aim of scientific research is to express its results in the simplest possible form, which is in general attained when they are reduced to numbers. These numbers are then used as the basis of new laws and principles, which help us to attain the scientific ideal—that of describing the universe in as simple a manner as possible. Not only science, but industry as well, is controlled by such numerical data. Up to the present time there has been no worldwide endeavor to collect the available data in such a form that it may be easily consulted, but at the first meeting of the International Union in 1919, it was decided to take up the preparation of a general set of critical tables through international cooperation. The cost of compilation was assigned to America, and the editorship to the National Research Council and the American Chemical and Physical Societies. While the object of the work is to tabulate existing data, it is found that when they are arranged, many easily determined and important data are missing, so the editor is ready to supply investigators with suggestions as to what work will aid most in making the tables as complete as possible.

Professor Kenrick, of the University of Toronto, showed that there are three different causes of the blue color of water: (1) Absorption, as in the water of a swimming tank; (2) scattering of light, which is the cause of the deep blue color seen on looking vertically into the sea in the tropics; and (3) reflection of the blue of the sky, which gives rise to the color of a lake or the sea as seen from the land.

An interesting report on the detection of small amounts of arsenic in plant tissue was presented by Dr. E. R. Schulz, of the U. S. Department of Agriculture, and a paper on gels and the theory of adsorption from solution by Professor Niel E. Gordon of the University of Maryland. A paper on the position of atoms in aliphatic hydrocarbon compounds was prepared by Maurice L. Huggins, of Harvard University.

A large audience was present to hear the joint program with Section G and the Physiological Section of the Botanical Society of America.[4] The general topic was "Photosynthesis in plants and other aspects of photochemistry." The program included the following papers: "Inventory of the world supply of energy," E. E. Slosson; "Analysis of the mechanism of photosynthesis," H. A. Spoehr; "The nature of photochemical reactions," W. T. Bovie; "Photochemical reactions," S. E. Sheppard; "Carbohydrate metabolism," Charles O. Appleman.

Practically all of the papers presented during the three days of the meeting were discussed at length by the chemists present. This discussion was constantly enlivened by the witty and relevant remarks and suggestions of the chairman, Professor W. Lash Miller, of Toronto.

The officers elected by the section were E. W. Washburn, of the National Research Council, Washington, D. C., as chairman and as vice-president of the association, and W. D. Harkins, of the University of Chicago, as secretary.

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[4] The details of this meeting will be presented in a report from Section G.

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GEOLOGY'S DEBT TO THE MINERAL INDUSTRY[1]

Of recent years it has come to be acknowledged more and more that the science of geology has done and is doing much to advance the mineral industry. On the other hand, it may be of interest to consider briefly what bearing the industry has had on the advancement of the science. In what state of development would geology now be were it not for the assistance it has received from the mineral industry?

In the earlier ages of man the chief interest taken in the components of the earth's crust, in most regions, was, doubtless, chiefly what may be called an economic one. Suitable specimens of flint and other rocks were sought for the manufacture of weapons and utensils. The soft oxides of iron and other paint materials would also early attract attention. In volcanic and earthquake regions other interests would be aroused. Gradually a knowledge of the use of metals would be developed and methods of extracting certain of them from the ores would be discovered by accident. In later ages the economic interest became subordinate to the philosophical. For many centuries little progress could be made in a proper knowledge of the earth's crust until restraining prejudices were gradually thrown aside. It was only at the close of the 18th century that the struggling science began to make real progress. Whatever may be thought of the relative merits of the so-called Neptunists and Plutonists of that time, it cannot but be admitted that Werner was largely responsible for creating a keener and more widespread interest in the proper study of the earth's crust than had existed prior to his day. And this interest was aroused chiefly through his showing that a knowledge of the structural relations of rocks could be applied to economic purposes. Thus, in what is acknowledged to be the very beginning of the science of geology as distinguished from cosmogony, credit has to be given to the mineral industry. No less an authority than Lyell makes this acknowledgment when he says in the Principles: "The phenomena observed in the structure of the globe had hitherto served for little else than to furnish interesting topics for philosophical discussion: but when Werner pointed out their application to the practical purposes of mining, they were instantly regarded by a large class of men as an essential part of their professional education, and from that time the science was cultivated in Europe more ardently and systematically." And Sir A. Geikie has said "the devout Wernerian put mines before mountains as a field for geological investigation."

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[1] Address of the vice-president and chairman of Section E—Geology and Geography, American Association for the Advancement of Science, Boston, December, 1922.

As further illustrating the fact that the founders of geology were much interested in the application of the science, the case may be cited of the "father of geology," William Smith, who lamented "that the theory of geology was in the possession of one class of men, the practice with another." Another example is that of Logan, usually considered to be the father of pre-Cambrian geology, who said of himself: "For many years of my life engaged in the active pursuits of a practical miner for coal, and a practical smelter of copper from its ores, my connection with geology relates more to the application of materials."

A well-known trait in human nature is that when people have become wealthy, especially if they have inherited their wealth and taken on airs more or less aristocratic, they tend to look down on trade and tradesmen. The same characteristic is observed among geologists. Although the science owes so much to its economic aspects, there is a tendency among many men to avoid having anything to do with the applications of the science. This does not apply so much to geologists in North America as to those in older countries, but even on this continent there is a tendency to make two groups, "economic geologists" and "geologists."

The tendency in some countries is exemplified by the case of a well-known professor, who was even a lecturer in a school of mines. In referring to the dangers to be encountered in economic geology he is quoted as saying "You cannot touch pitch without some of it sticking to you." Another distinguished geologist considered it to be *infra dig* for a colleague to give advice on water supply. In another case, a well-known geologist was told by his colleagues that it was not seemly for him to become an officer in a mining society. Further, is it not a fact that if geological papers are published by mines departments, or by mining journals, they usually become known only to those interested in the applied science? Many geologists appear to avoid reading anything that is published under the heading of mines and mining.

A recent writer, referring to work of geological surveys, says that they do provide for some research in pure science, and the by-product of pure science from both public and private work is large. This illustrates the mental attitude which too many geologists have toward government surveys. Are the scientific results obtained from the work, undertaken primarily for economic reasons by the U. S. Geological Survey, in the Lake Superior region, for instance, not entitled to be considered more than mere by-products?

Apropos of the prejudice against economic work, R. W. Brock has said "Geology started as economic geology . . . [But later] it became *infra dig* for a geologist to do anything that would be of value to anybody. He would no more think of applying geology to practical purposes than an artist would of contracting to paint an advertisement. . . . I remember when I was leaving the European university where I had been studying, the old professor under whom I studied said to me, "You are going to America, you will be in great temptation; I know they will try to make use of you in mining; whatever you do, have nothing to do with economic geology."

The advantages accruing to pure science from work undertaken chiefly in connection with the mineral industry is well illustrated in the Lake Huron-Lake Superior region. While Logan made a good start in unravelling the age relations of the Canadian pre-Cambrian rocks, he and his assistants were succeeded by men most of whom have been described by Van Hise, as regards the work of the pre-Cambrian, as "chromatic" map makers, the rocks being mapped largely according to their colors and not according to their age and structural relations. Little progress was made for many years after Logan's time, or not until some time after the discovery of important ore bodies at Sudbury and later at Cobalt and Porcupine. The finding of gold in the extreme western part of the Province also led to some important work there. If it had not been for the discovery of these valuable mineral deposits in the pre-Cambrian of Ontario, it is doubtful if much more would now be known regarding the age relations of these rocks than was known in Logan's time. Not long after Logan and his assistants ceased work in the pre-Cambrian the science of petrography arose. This science attracted many students of geology who would otherwise probably have done work on the stratigraphy of the pre-Cambrian in Canada. But the fascination of the new branch of science caused work in stratigraphy in regard to these most ancient rocks to be neglected. The students of petrography were interested in the minute structure of rocks, especially those of an igneous nature, and paid little or no attention to the age relations of the great masses of more or less metamorphosed sediments on which the history of the pre-Cambrian is so largely based.

But, while for many years after Logan's time little progress was made in the study of the Canadian pre-Cambrian, good work was being done on the United States side of Lake Superior by Pumpelly, Irving, Van Hise and others whose names will always be associated with the history of the development of these rocks. While the Ontario side was in darkness the lamp was kept burning on the American side, chiefly owing to the great copper deposits of Michigan and the iron mines of that and adjacent states.

Thus, were it not for the mineral industry in these Lake Superior States, probably even there little advance would have been made in the study of the pre-Cambrian beyond what was known in Logan's time. It was only the mineral industry that brought the expenditure of such large sums of money on both sides of the boundary in connection with the study of the pre-Cambrian. It is owing to the work of a large number of men, provided with excellent facilities, during the period of seventy years or more that progress has been made. It is fortunate for the science that these old rocks contain mineral deposits of exceptional value and interest—the greatest iron deposits, the greatest nickel deposits, and some of the greatest copper, silver and gold deposits that have ever been discovered in any country.

Referring to the Ontario side of the boundary it may be said that at Sudbury a knowledge of pre-Cambrian stratigraphy was not so important from an economic point of view as was the distribution and nature of the igneous rocks, more especially the norite, but at Cobalt much depended on stratigraphy, while at Porcupine and Kirkland Lake stratigraphy was again not so important. It may be of interest to add that one important result of the work, during recent years, in these mining areas has been the proving that the commonly accepted dual classification of the pre-Cambrian into Proterozoic and Archeozoic has no basis in fact and should be discarded. There are at least three major groups among these rocks.

The assistance which geology has received from the mineral industry is no better illustrated anywhere than in South Africa. In the early days of settlement in Cape Colony the existence of payable minerals was unknown, and the pioneers had difficulty in making headway with nothing valuable at hand for export or exchange. The discovery of diamonds in 1870 brought about a rapid change in conditions, as did also the discovery of gold in later years in the Transvaal. Had it not been for the discovery of the unsurpassed mineral deposits in the southern part of the continent the Boer farmer would still be occupying it in practically a pristine state. Is not the science of geology greatly indebted to the mineral industry in that part of the continent? Were it not for mining, the character and the wide distribution of those wonderful intrusives, the diamond "pipes," would have remained unknown in our time and for long after. Then, again, what a marvellous series of ancient sediments has been brought to light in the greatest gold field ever known, that of the Witwatersrand. Were it not for mining operations extending to great depths and laterally to great distances, the nature of these sediments, and especially of the comparatively thin beds of conglomerates, could never have been determined. Certain of these beds of conglomerate, that are the most important from a gold miner's point of view, have been proved to be the most persistent beds of the kind known in the world. But it must be borne in mind that no similar bed has ever offered the same inducement for complete investigation. The comparatively thin bed known as the Main Reef Leader has been proved to be practically continuous over a distance along the strike of at least forty miles and probably has a corresponding extension in the direction of the dip. Its nature could not possibly have been ascertained were it not for the extensive mining excavations and the numerous bore holes that have been put down over a large area in the search for productive gold-bearing rock.

These sediments, with which are associated the gold "reefs" or beds of conglomerate, have a thickness in the central part of the Rand of about 25,000 feet. While the research work which has been done on them was undertaken chiefly for economic reasons, it can be said that no great thicknesses of sediments, fossiliferous or otherwise, have been studied more fully than have these which are considered to be of pre-Cambrian age.

The origin of the gold is such an important factor, both from the economic and the scientific point of view, that the sediments have had to be studied with unusual care. Later workers on these ore deposits appear to be pretty well agreed that the gold was laid down with the conglomerate, forming a placer, but has since been dissolved and re-precipitated. Were it not for the economic importance of these rocks comparatively little would ever have been known about them. The character and origin of the remarkable beds of conglomerate and other features which belong to pure science would never have been determined. The same may be said of many other mining areas.

Another striking example of what the mineral industry has done and is doing to assist in bringing about a knowledge of the geological structure of remote and isolated regions is that of the petroleum geologist, who is often more or less maligned. A knowledge has been obtained of the fossiliferous rocks in remote parts of South America and in other parts of the world through the work of petroleum geologists within a comparatively few years that otherwise would have taken decades. The correctness of the conclusions of these geologists concerning the age and structural relations of these rocks is usually proved or disproved in a short time.

It will be acknowledged that Geological Surveys, supported by governments, have done more for the methodical study and mapping of wide areas than has any other agency, and there would be few, if any, of these surveys were it not that they are supported primarily with the object of describing and developing mineral resources. Even the greatest of Geological Surveys, that of the United States, owes its origin chiefly to economic reasons. The late S. F. Emmons has said that when the first Geological Surveys were established in the west the people had little conception of the advantages and uses of such an organization and a campaign of education of the popular mind was necessary in order to demonstrate its practical value. For ten or twelve years such a demonstration was carried on by the Hayden, King, Wheeler and Powell Surveys, or geological explorations, as they might more properly have been denominated. Most of them appealed to the popular, as well as to the scientific, imagination by their brilliant discoveries of such natural wonders as the geysers of the Yellowstone, the canyons of the Colorado, and the laccolites of the Henry Mountains. The Geological Exploration of the Fortieth Parallel, which alone planned to make a geological map of a definite and limited area, secured its appropriation from Congress on the explicitly economic ground that it was necessary for determining the character of the mineral resources of the mountainous regions to be made accessible by the recently authorized Transcontinental railroads. In furtherance of the plan of popular education, Mr. King, its organizer and chief, pushed to immediate publication the economic results of the work, the study of actually developed mines including the Comstock lode, set forth in a volume on Mining Industry which appeared in 1870, seven years before those embodying the more abstract scientific results which had to wait the completion of the researches of specialists. The final realization of the ultimate object that the geologists of the Fortieth Parallel Exploration had in their minds during the ten years spent on that work came much earlier than had been anticipated, when in 1879 all existing geological explorations were consolidated into a permanent Geological Survey, which was organized as a bureau of the Interior Department; and there is little doubt that the practical demonstration of the utility of such work furnished by the Mining Industry volume had much effect in rendering Congress favorable to the new organization.

A Canadian may be permitted to say that the geologists of the United States occupy a pre-eminent place in the world, and that the Geological Survey has had much to do in assisting them to achieve this premier position.

From what has been said concerning the geological work that has been done in the mining areas mentioned it seems difficult to draw the line between so-called economic geology and the pure science. Because a geologist is working out the age and structural relations of the rocks in a mining area, primarily with the object of aiding the mineral industry, is there any reason to believe that he has less love for the science or is less enthusiastic in its promotion than is one who spends his time studying the rocks in areas which are of no economic importance? Moreover, does not a man who works in an area where extensive mining operations are being carried on obtain more facilities for arriving at a proper understanding of the problems than he would if no mining was in progress? Undoubtedly some men find it more pleasant to work in areas that are free from economic problems. One of the older writers has said, "There may not always be found a geologist willing to turn away from his delightful studies to avert the ruin which can only fall on those who disregard the plainest truths of geology."

Cosmogony and geology both have had what may be called theological affiliations. While, on the one hand, the progress of geology was retarded by theological prejudices, on the other, theological controversies tended to popularize the science. The popularity of works such as those of Hugh Miller and Sir J. W. Dawson depend to a large extent on the fact that they deal with geology in its relation to theology. There was scarcely a Scotchman in the generation which has just passed away that had not heard of Hugh Miller and read some of his works. Even to this day a geological visitor to lonely Highland glens is likely to meet with a workman or peasant who is surprisingly well read in certain features of geology. Probably one criticism that could be made of the geologists of the present day is that they do not do nearly so much to popularize their science as did their predecessors in the last generation. As an illustration of the popularity of some of these older authors it may be said that even within the last twenty-five years sets of their writings have been found among the books offered to the Christmas trade.

Among those who have greatly helped in the advancement of the science there have been few who were men of independent means, such as Hutton and Lyell, and geology at the present time could not make much progress did it not depend chiefly on financial assistance from governments and those who are interested in the mineral industry. It is true, as has been said, that geology more largely than any other science is regarded as a governmental function.

That applied geology is not a new subject in this country is shown by the fact that in the first annual volume of the proceedings of the American Association for the Advancement of Science reference is made to the "Society for the Development of the Mineral Resources of the United States," which proclaimed that "With unabated admiration for all that part of geology which is strictly scientific we devote ourselves particularly to its œconomical department." From the quotation it will be seen that the objects of that early society were not unlike those of the Society of Economic Geologists organized a couple of years ago.

Since all economic work of importance in geology requires a thorough training in the principles of the science, and since there is such a variety in this work, it does not seem that the training of the man who expects to labor in mining and mineral areas should be different from that of the man who is to pursue the pure science.

In conclusion, if the science is under such a great debt to the mineral industry for facilities and opportunities provided, why should there be a tendency to ostracize the geologist who does work that has an economic value? Why should it be necessary to proclaim the legitimacy of applied geology? Let the man be encouraged who desires "to carry on economic research in a scientific way." Did not Edward Forbes, in the words he used long ago, express the correct attitude towards applied science? "When science, provided she be mindful of her honor, and make no sacrifices of her love of truth, serves as the handmaiden of even the humblest of arts, her dignity gains in lustre, and her familiarity breeds respect."

WILLET G. MILLER

DEPARTMENT OF MINES,
TORONTO, CANADA

THE SCHOOLMASTER AND THE TEACHER[1]

IT is very much to be feared that what I have here to say will appear so trite as to be little better than thrashing over of old straw. I am quite sure that much of it has been said (and perhaps better said) many times before. But no student of the problem of science teaching can observe the changes that are taking place in the system of scientific education, and particularly in the character of the results of the teaching of chemistry in our colleges and universities, without feeling that we still have much to learn about how to teach successfully. We cannot regard the subject as being closed. No one has yet discovered the grand secret in its entirety and no teacher of any branch of chemistry, who is both intelligent and honest, can be wholly satisfied with what he observes is going on in the minds of his students, as a result of his contact with them. This is my only excuse for reviving this ancient subject and for adding another bit to the already formidable accumulation of treatises directed toward the solution of such important questions as these.

I do not propose to offer to this section the affront of trying to tell you how to teach chemistry. Many of you have had far more experience in this field than I. Indeed, I frankly confess that I am not an authority on the art of teaching. If I were I should simply write out the recipe, and have it mimeographed and distributed; this you would then properly consign to the waste basket, for each one of you would know of a much better way than the one I would give you. There is no magic word or phrase that is the "open sesame" to the door of success in teaching. Each of us possesses, in some degree, the ability to instruct. But the part that one does well another does poorly. What both fail to attain another will accomplish, and so on. Were it not for this we should not be here to-day, gathered for a mutual exchange of ideas.

For this reason I shall presume upon your time and good nature long enough to say a few things about the general question and about some of the results of my own observations. These may be taken for just what you consider they are worth—no more (of course) and no less (I hope).

Much has been said and written about the necessary qualifications of a teacher. And, after all is said and done, we might finish by saying that the successful teacher of chemistry is one who can teach chemistry. Teaching is not coaxing or coddling, cramming or browbeating. Neither is it the administration of sugar-coated knowledge pills, to those who would cultivate the luxury of sleeping sickness. Our job is so to conduct our classes that our students shall be glad to be in them and that they shall leave them with regret, but carrying with them not only the fullest possible knowledge of the subject but also a deep and abiding respect and love for their chosen science and a boundless enthusiasm for its possibilities. Not an easy job, this, by any means,—as we all know. On the contrary it is one that requires large experience and training and large understanding of human possibilities, human ambitions and human habits of thought.

With this introduction and apology may I begin at what may seem to be the wrong end of the business by saying that the very first requisite for the teaching of chemistry is correct personality on the part of the teacher. This is not a prime necessity for successful work, for example, in chemical research or chemical industry. The researcher *must* have thorough training in fundamentals, thorough knowledge of chemical literature and a logical mind, capable of clear and systematic organization and prosecution of his work and, having these, he may be eminently successful even though his personality may be such as to cause him to be thoroughly disliked by all of his associates. Pray do not understand that I charge the industrial research chemists with such a lack of human characteristics. On the contrary, I know and admire many of these gentlemen who I wish to heaven were now in the teaching profession, because I know that their influence over our young students would be of enormous benefit to the progress of the science. I simply state that the research chemist *may* do without personality, though the teacher cannot.

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[1] Paper read at the Pittsburgh meeting of the American Chemical Society, September, 1922.

Much has been said, one way or another, about the correct method for developing the subject of chemistry in the class room and student laboratory and much more will be said. We want our students to understand that chemistry didn't simply happen but that as we have the science to-day it is the product of hard and careful work and of an infinite expenditure of human brain power, on the part of those who, in the past and present, have been able to search out and to reason, and who have known the virtues of cold, invincible scientific logic. How to impress this most satisfactorily is not an easy question to answer. I do not know just how to do it. I have heard discussed with much feeling the burning issue as to whether or not the beginner should be allowed to see (and use) a chemical formula before he has been taught how and why the formula was evolved. I do not know which is the right side of this question, although I know a great many other people who do know—both ways. What I know is that we may argue this question until doomsday but by neither the one system nor the other can the teacher ever inspire the student with either respect or love for chemical science except as this may be founded upon the prerequisite of respect and love for the teacher himself and that no one need expect ever to attain success in the work of science unless he has respect and love for that science. The student must believe what the professor is telling him and this belief must be so deep-seated that he is inspired thereby with enthusiasm to know more of that which forms the chosen life work of his teacher. In the very nature of things, such a working belief must have its origin, in the largest degree, in an interest springing from the personality of the teacher himself.

It may be that this is only "kindergarten stuff"—or it may not be. I am not a psychologist, though an observer of psychology as are we all. As I recall my own teachers in the grades, high school, college and university, I am more than ever convinced that it was only in the classes where my teacher was a respected and admired leader that I learned much that was of any lasting benefit to me. It may be that this was my fault. It might well be argued that it is always the business of the student to exert himself to the point of learning that for which he has entered the class, without regard to his personal feeling toward the instructor. However we are not so much concerned with an effort to place the blame for failures in teaching as we are to discover the failures themselves and to avoid them wherever possible.

The business of the teacher of chemistry is not simply that of handing over to the student, through an approved and standardized system of pedagogy, a set of facts and elaborately developed theories, with the invitation to take it or leave it. How often have we seen this tried—how often have we even had it tried upon us! "Here is chemistry," says the instructor, in effect, to us. "I am paid for giving you the opportunity to get it. If you want it, take it, if not, get out." The student can find no fault with this. The procedure is obviously just to him and the problem is thus placed squarely before him for his own solution. And yet is it not true that the result of such teaching is generally little better than a dull sort of forced interest,—at best a determination on the part of the student to "get by" in the course or to acquire a smattering of the subject, sufficient to do something in the way of earning a livelihood after graduation?

It may be that a teacher after this fashion earns his salary, in a technical sense, for he has gone through the motions of teaching a given number of classes of the correct number of students, properly and each day according to schedule. But I think that we all concede that the real work of the teacher of chemistry is something quite different from this. To him is given one of the most important trusts of science: that of helping to equip his students with that which should enable them to do useful and efficient work in a field that calls for the highest kind of enthusiasm and energy. Dullness and passive acceptance of a teacher's dictum has never and can never equip a young man or woman for work of this character.

The teacher of chemistry must himself be an original investigator. It is not essential that he shall have attained brilliant success in this field. It is only the exceptional few who are capable of that and most of us must be content with adding in a more humble fashion to the sum of scientific knowledge. But a professor of chemistry must do more than "profess." He is either going to leave with his students the impression that chemistry is now practically a finished story, with little more to be written, or else he must show them that it is a living science, the delving into which is a fascinating and necessary part of the activities of the devotee of chemistry. The student is not long in discovering that the first impression is erroneous, upon which he loses all confidence in his instructor that he might have felt. And the teacher can not consistently teach the second attitude unless he is himself doing something toward uncovering the hidden things of his science. Precept and practice must go together in this case or else the precept will become merely a dead formula.

The student of chemistry must be taught that chemistry, as all science, is the truth of nature and that as such it is to be respected. We may, and do, change our minds occasionally about whether a particular interpretation is the truth but we never doubt that science itself is truth and that before it all sham and pretense and hypocrisy must give way. This is the reflection that makes us respect science above all things and if we fail to bring the student to a full realization of it we have failed in our mission as teachers. Nothing else can supply the want of it and it is because of this want, in greater or less degree, that our colleges turn out too many men whose highest ideals of scientific work contemplate juggling with scientific knowledge and trifling with scientific truth in such a way as to win out in conflicts with other folk of similar character, whose wits are pitted against them. This (to use a bit of common slang) is why we have our shyster chemists as well as our shyster lawyers. The only way by which a teacher can instill a proper respect for chemistry into the life of the student is by showing in all of their mutual contact that he himself feels it intensely.

Carlyle tells us, in his vigorous and striking way, that the upheaval involved in the French revolution swept away all sham,—that imposture was burnt up by it. Which was, no doubt, true in the sense in which he wrote. But how long will it be before we shall have an end of sham and imposture in chemistry, before our fakers of science shall have been cast into the outer darkness of contempt? Too long, we are led to fear, when we contemplate the attitude of a certain fraction of our yearly crop of graduates, whose outlook upon life and whose sense of responsibility toward the cause of science has suffered through too much contact with schoolmasters of science and too little companionship of teachers.

One of the most difficult of tasks imposed upon the teacher of chemistry and other science is that of creating in the minds of his students the proper attitude toward questions of religious belief as they are related to scientific study. I have heard the "conflict" between science and religion discussed *ad nauseam* for so many years that it has become almost a positive discomfort to me to attend church services, especially in a college town where so much attention is given by religious teachers to students of science who are trying to straighten out their mental troubles along these lines. And trying vainly, it seems to me, in most cases, largely because they have not the proper help from the source upon which they have the right to place the most reliance,—that of the teachers of science in the college. What usually happens is that the college teacher goes right ahead with the thing he is paid for doing. That is, he teaches his science and nearly or entirely ignores religious questions because he knows (whether he proclaims it publicly or not) that the study of science is the search for truth by absolutely the only method that can ever discover truth,—that of experimentation and logical reasoning,—but that our religious leaders will not and can not admit this without giving up a great mass of what they mistakenly consider as essential to religion.

The student is thus left entirely to his religious leaders for instruction in matters that are of great and vital concern to him. The religious leader is too often nearly or entirely untrained in matters of science and in scientific methods of thought and (still more unfortunately) he is frequently unaware of his own limitations in this respect. It, therefore, happens that there come from our pulpits and our Sunday School classrooms great quantities of instruction designed to quiet the "doubts" of students of science, the religious instructor making use of a patter of scientific words and phrases, abused and garbled, with good intentions, but with lack of understanding, so that the student is more or less self-hypnotized into a temporary state of mental quietude concerning these matters.

If affairs were as they should be, our teachers of science would be perfectly correct in confining their efforts to the teaching of their own special phase of science. For true religion is a matter of the soul and it has little or nothing to do with any science, unless it be that of psychology. But *what passes for religion* in the minds of many (if not most) people is of very vital concern to the scientist because it contains a mass of dogma which can not be reconciled with the truths of science as we accept them and which is not susceptible to test by any method. And I maintain that no teacher of chemistry, biology, physics or any other science can consider his duty to his students as fulfilled if he allows them to cultivate one attitude and acquire one set of ideas in the classroom and another, incompatible with the first, in the pew. They will ultimately either come to a point of forsaking their religious beliefs entirely or to that of passive acquiescence in something which they can not, really and truly, believe. The latter is a state of mind all too common to-day and it is not a healthy state for either true science or true religion.

I have not meant simply to inflict a preachment upon you,—many of whom know far better than I of the things of which I have briefly spoken. But it has seemed to me desirable once again to direct our thoughts toward the problems of teaching,—not as they relate to the preparation of the student, the system of teaching or the arrangement of content of courses —important as all of these are,—but as they go back to the teacher himself, for upon him as a man must finally rest the responsibility for failure, as well as the credit for success. The truly successful teacher is the one who constantly studies himself as he watches the effect of his efforts upon the minds of his students and who continually tries to correct his failures and to strengthen his successes, putting himself in the place of the student, always. We have all had our schoolmasters and our teachers. We have but to project ourselves backward through the years to see examples of what we would wish to be, as well as of what we hope never to be.

E. G. MAHIN

PURDUE UNIVERSITY

BERNHARD EDUARD FERNOW

DR. BERNHARD EDUARD FERNOW, author, pioneer educator, organizer of the forestry movement, and the first United States Forester, after a long illness died at Toronto on February 6 at the age of 72.

Dr. Fernow was a native of Germany and studied under the famous Heyer and other noted foresters. He first came to this country in 1876 and soon took an active part in the forestry movement of New York State, where he formulated legislation establishing the Forest Reserve in the Adirondacks. From 1885 to 1898 he was editor of the *Proceedings* of the Forestry Association. Sponsored by this Association was the greatest piece of forest legislation so far adopted in our country—the law of 1891 authorizing the President of the United States to establish National Forest Reserves. This act led to the creation of the present National Forests.

In 1886 Dr. Fernow's great work for the nation really began, when he accepted the position of organizer and director of the forestry work of the government for the Department of Agriculture, a position which he occupied until 1898.

During twelve years at Washington Dr. Fernow kept in close touch with the forestry work in the various states and there was little of state forest legislation passed during this time in which his opinion was not consulted. He secured the cooperation of many prominent men of science and the numerous bulletins and circulars including monographs on white pine, the southern timber pines; results of tests and studies in timber physics, the first complete discussion of the metal railway tie as a possible substitute; studies on timber impregnation and other subjects all of immediate value in wood utilization are evidences to-day of the painstaking work of the guiding spirit which directed them and edited their results for publication.

Throughout the twelve years in the Department of Agriculture Dr. Fernow never ceased to write articles and addresses. In these years the larger part of two hundred articles and addresses, over twenty circulars, and over thirty bulletins and reports were prepared and edited.

In 1898 Dr. Fernow was called to Cornell to organize the first forestry school in the new world. Here he inaugurated the beginnings of professional education. The school grew rapidly, but the forest operations in the college forest in the Adirondacks met with opposition of wealthy camp owners. In 1903 the Governor vetoed the appropriations of the forestry school and this resulted in its discontinuance. After leaving Cornell he worked for four years as consulting forester. During these four years he continued the *Forestry Quarterly;* delivered lectures at Yale University, and started the forest school at Pennsylvania State College. In 1907 Dr. Fernow accepted an invitation to Toronto University and organized the first forest school in the Dominion. At the time of his death he was professor emeritus of that institution.

His well-known "History of Forestry" is a masterpiece of its kind, covering the subject for both the Old and New World.

Three years ago when Dr. Fernow retired from active teaching there was published in *American Forestry* a tribute by Raphael Zon to the father of forestry in the new world. To-day the words assume an added significance. "While the period which Dr. Fernow typifies is rapidly becoming history, his teachings and his contributions have the equality of permanence. They have been always a source of inspiration and guidance to the pioneers of forestry; they will be infinitely more so to the actual managers of our forest lands as soon as real woods forestry comes into general practice. As with any great teacher, it is not the kind of theory that he happens to advocate that really counts, but the ability to teach how to think in his particular field. Theories come and go, but the ability to orient oneself in the details of complex problems is a lasting asset; he who teaches to meet ever-changing problems, not by a ready-made theory or hypothesis, but by a critical attitude and ability to discern between the essential and non-essential, is building on a solid foundation. With him forestry was not merely theory but a movement ever changing as life itself, and for him problems became soluble not in ready-made formulas, but in the forces, economic and natural, that are at work."

X.

GEORGE LEFEVRE

George Lefevre, professor of zoology in the University of Missouri and chairman of the department, died on January 24, after a brief illness with pneumonia. The foregoing announcement marks the passing of one who was probably the best loved man in the American Society of Zoologists, a man whose brilliant intellectual endowment and gifted nature marked him as a unique personality. Born of old American stock and inheriting his name from a Huguenot ancestor who immigrated at an early date, he was the son of a prominent Presbyterian clergyman who raised his children on good English, the Classics and the Shorter Catechism, and who read his original Greek and Hebrew almost to the day of his death.

After Professor Lefevre's graduation from a famous boys' school in Baltimore, the family spent a year in European travel; and although he was too young to profit scientifically by the experience, this European sojourn became an invaluable part of his cultural education. During his earlier boyhood the family spent long vacations in the country near Baltimore, where he acquired an interest in natural history and became an ardent amateur naturalist. It is, therefore, not surprising that he should have been attracted to zoology after his entrance to the Johns Hopkins University. Here he received a fundamental scientific training under the influence of Remsen, Rowland, Martin, Brooks and others of that generation. Throughout his life he remembered with pride that as an undergraduate he studied under such influences. His graduate work in zoology was pursued in the same institution and after an unusually thorough training extending from 1891 to 1896 he received the doctor's degree. After a further apprenticeship as an assistant at the Hopkins, he taught in Atlanta, Georgia, in the year 1898-99; and in the fall of 1899, was appointed professor of zoology in the University of Missouri, which position he held until his death. At the Hopkins he was commonly regarded as one of the most brilliant men who had ever been enrolled in zoology. His ten years as undergraduate and graduate he sometimes regretted because of the continuity of associations. But they gave him a foundation that few men obtain and one that was in evidence throughout his life.

From the beginning he occupied a prominent place upon the faculty of the University of Missouri. Probably no man not in one of the major administrative positions exercised greater influence, and personally there was none who equalled him. He was always loaded with a burden of committee work of the most diverse sort from which he was never released, because his idealism, good judgment, courtesy, and unquenchable humor rendered his services indispensable. In his own department his personality was unfailing and the tradition of its *esprit de corps* is known throughout the country. The present biological building with its admirable arrangement and equipment is his creation more than that of any other man, for he enjoyed the confidence alike of architect and university administration and his leadership in the team-work of his department yielded a remarkable return for the investment. But more than this his name is written in the hearts of students and colleagues through his ideals as a scholar and a man and through the charm of his personality. Among his associates on the faculty he was universally recognized as a man of the finest intellectual quality. His keenness of wit, his gift in conversation, and his social graciousness made him a marked man, whose friendship was prized and who was admired by all who understood the spirit within him.

The Lefevre laugh will be remembered by every one who knew him; also his stories, for he possessed a gift of mimicry along with his sense of humor. One of his friends who knew him best once dedicated the following lines to his brave spirit of laughter that often masked an unsuspected burden:

TO THE MAN WHO LAUGHS

A health to my friend
With spirit blythe!
  From Cavaliers of old
Who laughed at fate,
Perchance came down
  That spirit which makes him bold.

Let Roundheads sigh
Sit sourly by
  And scorn the fleeting show
But men like you
They dare and do
  And jest 'neath stinging blow.

Who hath seen his dead,
But with spirit uncrushed
  Hath faced his life anew
With a smile on lip,
Though the heart went white,
  And won to happiness new.

Who when death comes,
Though others quail
  And silent its bitterness quaff,
Shall laugh at death—
So all may know
  What glory it is to laugh.

In the matter of publications, what he did was done with the finish of a master workman, and those of us who were associated with him know that his scientific mind was eternally active. Studies upon the morphology and embryology of the Tunicata constituted the work of his student days. A paper upon "Artificial parthenogenesis in Thalassema" (1907) is representative of his interests from 1902 to 1906. An extended investigation of the "Artificial propagation of fresh-water mussels," in collaboration with the writer of this article, occupied some half dozen years before it was finally published in 1912; while lesser papers in cytology by himself and his students marked his dearest interest. Cytology and genetics absorbed his attention in recent years. Under the auspices of the agricultural experiment station at the University of Missouri he carried out an investigation of the inheritance of certain coat colors in poultry, the last paper of which was on his desk completed and ready for mailing at the time of his death.

In recent years his physical well-being was seriously impaired, and no doubt his untimely end was the indirect result of a long-standing disability. When a graduate student he underwent a serious operation supposedly for appendicitis. What was actually done was to drain an abscess and save his life. The abnormal conditions thus produced followed him throughout the remainder of his life. This circumstance, and the tragic death of his first wife in 1900, the year following their marriage, laid upon him a burden that many men could not have endured. But he was outwardly cheerful and uncomplaining. In 1914 increasing difficulties rendered an exploratory operation imperative. Gall stones and his supposedly absent appendix were then removed. A year for recovery and a few years of comparative comfort, then further intestinal disorders, more comfort when he was assured in 1921 that it was nothing more serious than adhesions of the old wounds, but an obvious frailness of body that alarmed his friends, until in recent months he seemed fit to succumb to any serious disturbance, although there was no flagging of spirit.

On Monday, January 15, he presided at a departmental meeting in his inimitable fashion, on Wednesday he conducted his seminary and seemed at his best, a week in bed and he died on the evening of the Wednesday following, at the time for the customary assemblage of students at his home. Would that it could be given to all of us to go out of life like that, having fought so good a fight and having preserved such spirit to the end.

Professor Lefevre leaves a wife, having married Julia Faris in 1914. A son, who bears his name, already shows many of the traits that so endeared the father to his associates. The loss is irreparable. But the present George Lefevre will never lack devoted friends. His father was a scholar—and more than that, he was, to those of us who loved him best, the finest gentleman we ever knew.

W. C. CURTIS

UNIVERSITY OF MISSOURI,
FEBRUARY 1, 1923

SCIENTIFIC EVENTS

THE NEW ELEMENT HAFNIUM

DRS. COSTER and G. HEVESEY write from the laboratory of theoretical physics of the University of Copenhagen to *Nature* on January 21 as follows:

In a former letter to *Nature* (January 20) we announced the discovery of a new element with atomic number 72, for which the name hafnium was proposed. Evidence was given that this element is a homologue of zirconium in accordance with theoretical expectations (Bohr, "Theory of Spectra and Atomic Constitution," p. 114, Camb. Univ. Press, 1922). Continued experiments enable us to complete the statements in the former letter. By the addition of a known quantity of tantalum (73) to our samples, and by a comparison of the intensity of the Ta-lines with the Hf-lines, a closer estimate of the amount of hafnium present has been obtained. We have investigated a great number of zirconium minerals from different parts of the world. They all contained between five and ten per cent. of hafnium. In samples of commercial zirconium oxide investigated, we have found the new element, amounting in one case to as much as five per cent. Starting from the latter substance, by means of a chemical method which is also adapted to separate zirconium from the other tetravalent elements, we have been able to obtain several grams of a preparation in which the presence of about fifty per cent. of hafnium could be established. Conversely, we have succeeded in preparing zirconium in which no hafnium lines could be observed. Further particulars about the method of preparation and provisional determination of the atomic weight will be published shortly in the communications of the Copenhagen Academy.

In an editorial note *Nature* says:

Since the publication of the letter "On the Missing Element of Atomic Number 72," by Dr. Coster and Professor Hevesey, in *Nature* of January 20, p. 79, it has been announced that Dr. Alexander Scott detected and separated the oxide several years ago. It appears that while examining in 1913 a specimen of titaniferous iron sand (75 per cent. Fe_3O_4, 25 per cent. TiO_2) from near Maketu in the North Island, New Zealand, Dr. Scott noticed that in the titanium dioxide separated in the ordinary methods of analysis there was always a small residue which resisted all attempts to get it into solution, either as sulfate, chloride or nitrate. Neither would it go into solution after prolonged fusion with caustic soda. No trace of the many "rare earths" was found in the sand. The insoluble residue remaining after repeated and alternated fusions with sodium bisulfate and caustic soda was labeled "New Oxide" in 1918. Its properties and mode of occurrence indicated that it was an oxide of the titanium-zirconium group, and that it was the oxide of the missing element, of which the atomic number is 72. Some of its properties showed a resemblance to tantalum, its next neighbor, with the atomic number 73; but all traces of this element would be removed by the repeated fusions with caustic soda. As none of the ordinary salts were available for the purpose of determining the atomic weight, recourse was had to the double fluoride with potassium, which closely resembles those of titanium and zirconium. The rough determinations with material imperfectly purified for such a purpose indicated that the atomic weight of the element was between one and one half and two times that of zirconium (90.6). The oxide resulting from these determinations was of a cinnamon-brown color, not white as was expected. We understand that Dr. Scott wrote on January 28 to Drs. Coster and Hevesey offering to send them specimens of his separated material to compare with their own, and received a reply from them on Saturday night last (February 3) saying they would be very glad to do so. On Monday Dr. Scott sent to them practically all his purified material, and not only he, but also all scientific men, must await with keen interest the result of the searching examination by means of the powerful appliances in their hands for spectral analysis by X-rays. In view of the source of his oxide and its association with much titanium oxide, Dr. Scott has suggested, as Oceanus was one of the Titans, that "Oceanium" would be a suitable name for the element. This name would also recall that the sand came from Oceania, of which New Zealand is one of the component parts.

GEODETIC AND TIDAL SURVEYS

A CONFERENCE was held in Ottawa on January 2, 3 and 4, at which officers of the United States service discussed with Canadian officials problems common to the two countries. The visitors were Dr. William Bowie, chief of the Division of Geodesy of the United States Coast and Geodetic Survey, who conferred on geodetic work with Dr. E. Deville, director general of surveys, and Mr. Noel Ogilvie, director of the Geodetic Survey of Canada, and Mr. G. T. Rude, chief of the Division of Tides and Currents, who met Dr. Bell Dawson, superintendent of the Tides and Current Surveys of Canada, and discussed tidal data.

The cooperative geodetic plan includes primary or precise triangulation along the international boundary from Lake Superior to the Pacific coast, and extension of triangulation in Idaho, Oregon and Washington to the Canadian boundary. On the Pacific coast similar cooperative work is being carried on from northern Washington through British Columbia to the Yukon territory and Alaska. The plan also includes several lines of precise leveling for strengthening the precise level nets of both countries.

The triangulation and precise leveling will be available to both countries for all classes of work needing precise control. The result will be coordination in the surveys of the two countries, and the geographical positions of boundary monuments will be the same on the maps of each. Accurate maps are possible only after the precise establishment of geodetic control points, and on accurate maps the development and prosperity of any country largely depend. Accurate maps have also an important influence in promoting cordial international relations.

Referring in one of his public addresses in Ottawa to cooperative geodetic work, Dr. Bowie stated that, as far as triangulation and precise leveling were concerned, there was one geographical unit for Canada, the United States and Mexico. He added that North America was the only continent that could boast of this uniformity, and that Europe for years had been struggling, so far unsuccessfully, to obtain the same result. Geodetic cooperation between Canada and the United States was most conspicuous and most happy.

Mr. Rude spoke of the importance of accurate charts and of a thorough investigation of facts relating to tides and currents. He referred also to the cooperation that existed between Great Britain, Canada and the United States in regard to the interchange of such knowledge.

COLLOID CHEMISTRY

WITH the assistance of prominent specialists the world over, I am preparing a comprehensive book on Colloid Chemistry, Theoretical and Applied. The extensive and international character of the book is evidenced by the subjoined list of some of those who have already promised contributions:

United States: E. G. Acheson, W. D. Bancroft, Carl Barus, M. H. Fischer, W. D. Harkins, H. N. Holmes, G. A. Hulett, D. D. Jackson, G. F. Kunz, R. S. Lillie, D. T. MacDougal, S. E. Sheppard, A. Silverman, E. B. Spear, E. W. Washburn, A. W. Thomas, H. A. Gardner. England: E. F. Armstrong, Henry Bassett, W. M. Bayliss, E. F. Burton, W. B. Hardy, F. G. Donnan, F. E. Lloyd, A. E. Dunstan. Germany: H. Bechhold, G. Bredig, A. Fodor, H. Handovsky, A. Lottermoser, Lüppo-Cramer, R. Höber, W. Ostwald, H. Plauson, E. Stiasny, G. Tammann, H. Schade. Austria: C. Doelter, W. Pauli. Jugoslavia: M. Samec. Sweden: Sven Oden. Holland: H. R. Kruyt. Mexico: A. L. Herrera.

Many unusual experimental facts and practical applications of colloid chemical principles are unpublished, and the object of this letter is to ask any one in any field of science or experience who may have information of interest to send me a brief statement for inclusion in the book.

Contributions may consist of a paragraph, a page, or several pages, and will (unless contrary request is made) be duly acknowledged. If possible they should be submitted in English and duplicate copies will be appreciated. Authors should state their full names and titles.

The editors of scientific, technical and cultural publications in all countries are asked to disseminate this appeal.

Jerome Alexander

50 East Forty-first Street,
New York City

DR. PAUL WAGNER

On the seventh of March, the noted German agricultural chemist and investigator, Dr. Paul Wagner of Darmstadt, will complete his eightieth year, at which time his numerous friends and pupils in Germany will hold a celebration at Darmstadt in his honor.

Fifty years ago, Dr. Wagner became director of the Experiment Station at Darmstadt, which had just been founded, and has since won for this institution a world renown, through his investigations on plant foods. He certainly deserves to receive great commendation for having, with the help of his own method of pot experiments, substantially extended and firmly established the foundation for the use of commercial fertilizers.

He was the first to recognize and correctly estimate the fertilizing effect of the Thomas phosphate or basic slag. By a steady improvement in the methods of fertilizer experiments in the field, he succeeded in making of these field experiments a practical means of exact investigation.

Dr. Wagner, furthermore, has clearly shown the results of his investigations in the vegetation house, field and laboratory to the practical farmer, both in articles which are easily understood and in inspiring lectures; and in this way he has contributed in an enormous degree toward the proper use of commercial fertilizers in agriculture.

Here in the United States, many of Dr. Wagner's articles are known, having been translated or summarized by numerous writers to the great advantage of American agriculture.

H. A. H.

SIGMA XI LECTURES

The following public lectures were given before the Iota Chapter of the Society of Sigma Xi, University of Kansas:

Dr. Henry B. Ward, professor of zoology, University of Illinois: January 10, "The struggle of man with the life of the wilderness in North America," and "The factors which control and direct the migration of the Pacific salmon."

Dr. A. Sommerfeld, professor of mathematical physics, University of Munich, at present holding the Karl Schurz memorial professorship at the University of Wisconsin: Jan. 20, "Atomic structure and periodic system of elements."

Officers of Iota Chapter are:

President, F. B. Dains, professor of chemistry.

Vice-president, W. S. Hunter, professor of psychology.

Secretary, Guy W. Smith, assistant professor of mathematics.

Treasurer, H. E. Jordan, assistant professor of disseminate this appeal.

In a visit to the University of Oklahoma Dr. Henry B. Ward, national president of Sigma Xi, addressed the local Sigma Xi Club on the evening of January 11 on "The struggle of man with the life of the wilderness in

North America." Dr. Ward also addressed the general student body on the morning of January 12, giving an illustrated lecture on "The factors which control and direct the migration of the Pacific salmon.". He came to the University as guest of the local Sigma Xi Club.

GRANTS FOR RESEARCH MADE BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Committee on Grants held its annual meeting in New York on December 31, 1922, and distributed four thousand dollars which was assigned by the council of the association for the year. Two members of the committee, Messrs. Moulton and Lamb, having retired at the end of the year 1922, the present organization of the committee is: Robert M. Yerkes, *chairman;* William D. Harkins, *secretary;* E. G. Conklin, C. Judson Herrick, George T. Moore, E. L. Nichols, Frank Schlesinger and David White. The committee elected a secretary for a term of four years.

The grants made for the year 1923 are listed below:

ASTRONOMY

No. 102: W. W. Campbell, Mt. Hamilton, Cal., $225 for assistance in constructing an interferometer for use in measuring double stars.

No. 103: Bernhard H. Dawson, LaPlata, Argentina, $300 for assistance in preparing catalog of 7,800 southern stars.

BOTANY

No. 104: S. M. Zeller, Corvallis, Oregon, $250 for aid in study of Humenogastrales of North America.

No. 105: John T. Buchholz, Fayetteville, Ark., $125 for aid in continuing work in quantitative studies of pollen tube growth, etc.

No. 106: Albert R. Sweetser, Eugene, Ore., $125 for aid in work on flora of the Kerby Quadrangle.

CHEMISTRY

No. 107: A. W. Rowe, Evans Memorial, Boston, Mass., $300 for providing apparatus for studying rate of oxidation of ether.

No. 108: S. A. Mahood, Tulane University, New Orleans, La., $200 for assistance in study of cellulose chemistry.

No. 109: H. I. Schlesinger, University of Chicago, $300 for part payment of Hilger quartz spectrograph.

GEOLOGY

No. 110: V. C. Allison, Bureau of Mines, Pittsburgh, Pa., $150 for assistance in study of rate of growth of stalagmites.

No. 111: Ferdinand Canu, Versailles, France, in collaboration with R. S. Bassler, U. S. National Museum, Washington, D. C., $250 for aid in continuation of study of recent Bryozoa in Gulf of Mexico, etc.

No. 112: Taisia Stadnickenko, Poughkeepsie, New York, $200 to assist in micro-chemical study of oils, shales and coal.

MEDICINE

No. 113: H. V. Atkinson, University of Texas, Galveston, Texas, $200 to continue study of changes of blood under influence of drugs.

No. 114: M. S. Fleisher, St. Louis School of Medicine, St. Louis, Mo., $200 for expenses in studying yeast-like organisms in human beings.

No. 115: O. F. Kampmeier, University of Illinois Medical School, Chicago, Ill., $100 for assistance in completing monograph on morphology of lymphatic systems of vertebrates.

PSYCHOLOGY, PHILOSOPHY, EDUCATION

No. 116: Kline and Carey, Skidmore College, Saratoga Springs, N. Y., and Duluth, Minn., $300 for aid in constructing measuring scale for free-hand drawing.

No. 117: S. L. Pressey, Ohio State University, Columbus, O., $200 for assistance in X-O emotional tests.

PHYSICS

No. 118: L. Thompson, Kalamazoo College, Kalamazoo, Mich., $100 for constructing chronographs.

ZOOLOGY

No. 119: F. B. Hanson, Washington University, St. Louis, Mo., $250 for assistance in studying experimental modification of the germ plasm.

No. 120: Raymond Pearl, Johns Hopkins University, Baltimore, Md., $225 for partial payment of X-ray apparatus for studying *Drosophila*.

W. D. HARKINS,
Secretary

UNIVERSITY OF CHICAGO

SCIENTIFIC NOTES AND NEWS

DR. ARTHUR A. HAMERSCHLAG, former president of the Carnegie Institution of Technology, has been elected to the presidency of the Research Corporation. Its principal office is in New York City and Dr. Hamerschlag will give part of his time to its work, although he will retain his residence and office in Pittsburgh. The Research Corporation, it will be remembered, has been endowed by the gift of the patents for electrical precipitation of Dr. F. G. Cottrell. The directors are: Elon H. Hooker, John J. Carty, T. Coleman DuPont, Frederick A. Goetze, Otto H. Kahn, Charles D. Walcott, Floyd N. Scott, Dr. Ellwood Hendrick, Howard Poillon.

Charles F. Rand, of New York, has been reelected chairman of the Engineering Foundation, which is directing a national program of industrial research, in cooperation with the National Research Council. Edward Dean Adams, of New York, was elected first vice chairman; Frank B. Jewett, president of the American Institute of Electrical Engineers, second vice chairman, and Joseph Struthers, treasurer. Dr. W. F. M. Goss, president of the Railway Car Manufacturers Association, was elected to the board to succeed George M. Basford, and Colonel Arthur S. Dwight, past president of the American Institute of Mining and Metallurgical Engineers, was named a director to succeed Edwin Ludlow.

Professor E. de Margerie, of the University of Strasbourg, during the month of February gave eight lectures on the work of French geologists and geographers at Cornell University. He is in this country as exchange professor and is dividing his time among the six American institutions that share in this exchange with France. They are: Harvard, the Massachusetts Institute of Technology, Yale, Columbia, Johns Hopkins and Cornell.

Dr. H. V. Arny, professor of chemistry at the College of Pharmacy, Columbia University, has been elected president of the American Pharmaceutical Association.

One of the most prominent Central American physicians, Dr. A. Quiñones Molina, was elected president of El Salvador, at the recent election.

Dr. G. H. Carpenter, professor of zoology at the Royal College of Science, Dublin, has been appointed keeper of the Manchester Museum.

Professor Louis C. Graton, of Harvard University, has been elected a director of the Society of Economic Geologists.

Dr. Richard R. Lyman, professor of engineering, was recently appointed regent of the University of Utah. Dr. Lyman is a graduate of the University of Michigan, and has been a member of the faculty of the University of Utah since he finished his graduate work at Cornell.

Lewis Radcliffe has resigned as assistant in charge of the division of fishery industries under the Bureau of Fisheries to take a position with the Tariff Commission.

Richard V. Ageton, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

Dr. W. Reid Blair has been appointed to the newly created position of assistant to the director of the New York Zoological Park. Dr. Blair will continue to act as park veterinarian.

Dr. P. D. Rodriguez Rivero has been appointed director general of health of Venezuela, to succeed Dr. L. G. Ghacin Itriago.

Dr. H. W. C. Vines, fellow of Christ's College, Cambridge, has been appointed to a Foulerton research studentship of the Royal Society, the duties being to conduct researches in medicine or the contributory sciences. Dr. Vines is carrying on his researches in the Cambridge Medical School.

With the arrival of Professor Zschokke has commenced an exchange of teachers between the University of Cambridge and Basel University. Professor Zschokke will give a course of sixteen lectures on the European fauna.

George S. Rice, the chief mining engineer of the Bureau of Mines, has been selected as the bureau's delegate to attend the mining exposition and conference which will be held in London from June 1 to June 14. Following the exposition he will visit other countries of Europe to continue his study of mining methods and the use of liquid oxygen.

Professor W. L. Badger, professor of chemical engineering at the University of Michigan, is taking a year's leave of absence beginning on February 1. He expects to continue his research work on evaporator design in Ann Arbor.

Captain Otto Sverdrup has left Trondhjem for the north, where he is to prepare, at the request of the Norwegian government, a base for the examination into ice conditions in the Arctic Ocean, special regard being had to transport from Spitsbergen.

DR. E. V. COWDRY, of the Rockefeller Institute for Medical Research, delivered the seventh Harvey Society Lecture at the New York Academy of Medicine on February 24, on "The significance of the internal reticular apparatus of Golgi in cellular physiology."

THE Sigma Xi Club of Southern California held a special mid-winter meeting at the University of Southern California, Los Angeles, on the evening of February 10. Following a reception tendered by the Faculty Science Club there were addresses by Dr. James G. Needham, of Cornell University, and Dr. A. B. Stout, of the New York Botanical Garden, both of whom are spending the year at Pomona College.

DR. WILLIAM D. HARKINS, professor of physical chemistry at the University of Chicago, will give a course of three technical lectures on March 7, 8 and 9 at Carnegie Institute of Technology, Pittsburgh. He will discuss "Isotopes" and "Building and disintegration of atoms."

AT the Royal Institution, on February 13, Professor A. C. Pearson delivered the first of two lectures on "Greek civilization and to-day"; on February 15, Professor B. Melvill Jones began a course of two lectures on "Recent experiments in aerial surveying"; and on February 17, Sir Ernest Rutherford commenced a course of six lectures on "Atomic projectiles and their properties." The Friday evening discourse on February 16 was delivered by Professor A. V. Hill on "Muscular exercise"; and on February 23 by Professor A. S. Eddington on "The interior of a star."

M. JUSSERAND, the French ambassador in Washington, has stated that an offer to purchase the house in which Pasteur was born has been made by Mr. John D. Rockefeller, with a view to the establishment of a museum.

A MEMORIAL service for Dr. John A. Wyeth, distinguished surgeon and scholar, who died in May, 1922, was held on February 27, at the New York Polyclinic Medical School and Hospital. Dr. Wyeth founded the Polyclinic in 1881. In 1882 he established the first post-graduate medical school in the country. The program for the services included an invocation by the Reverend Dr. Charles H. Parkhurst, president of the board of trustees of the hospital; an address by Dr. Samuel W. Fairchild, and a tribute by Dr. Marion J. Verdery.

DR. JOHN WADDELL, associate professor of chemistry and librarian of the science department at Queen's University, Kingston, died recently at the age of sixty-four years.

THE Hon. Richard Clere Parsons, a well-known engineer, died in London on February 26, after a short illness, in his seventy-second year. Born in 1851, the third son of the third Earl of Rosse, the astronomer, he was elder brother of the Hon. Sir Charles Parsons, F.R.S., the great turbine engineer.

DR. FRITZ COHN, director of the Berlin Rechen-Institut and professor of theoretical astronomy in the university, died on December 14 at the age of fifty-seven years.

THE death is announced of Dr. A. Carruccio, professor of zoology and parasitology at the University of Rome, and of Dr. E. Cavazzani, professor of physiology at the University of Ferrara.

THE American Institute of Chemistry was organized at a meeting of local New York chemists on February 5. Dr. H. C. Byers, in charge of the department of chemistry at Cooper Union, and Dr. Lloyd Van Doren, a chemical patent lawyer, were elected, respectively, president and vice president. The secretary is Lloyd Lamborn, editor of *The Chemical Age*. The general purposes of the organization include the compilation of a code of ethics and the promotion of popular appreciation of chemical research and control in the industrial field.

THE thirty-ninth session of the American Association of Anatomists will be held in Chicago on March 28, 29 and 30, under the presidency of Dr. Clarence M. Jackson, professor of anatomy at the University of Minnesota Medical School.

IN connection with the announcement that the trustees of the New York Academy of Medicine have acquired an option on a site for a new building at Sixtieth Street and Park Avenue, it is announced that on condition that the members of the academy acquire an appropriate site the Rockefeller Foundation will contribute $1,000,000 for the erection of a new building and that the Carnegie Foundation will contribute an endowment fund sufficient to care for the increased needs of its library and the enlarged educational activities that the institution is planning to carry on.

Consolidation of the State Agricultural Experiment Station at Geneva with the College of Agriculture at Cornell is the object of a bill to be introduced in the New York State Legislature in the near future. The bill is not opposed by the administrative body of either institution. The object of the consolidation is to coordinate the research work of the two so that duplication of effort may be eliminated.

We learn from the *Journal* of the American Medical Association that during the proceedings at Chicago, March 5, 6 and 7, of the annual congress of the council on health and public instruction of the American Medical Association, a meeting will be held on the afternoon of March 7 with the Public Health Service for the discussion of public health. At this meeting, over which Surgeon General H. S. Cumming has been asked to preside, the following program will be given: "Education of sanitarians and the future of public health in the United States," by Dr. H. S. Cumming, a report on the activities carried on by the Public Health Service since the conference of last March on the education of sanitarians, by Assistant Surgeon General W. F. Draper; "Recruiting and training of sanitarians," by Dr. C.-E. A. Winslow; "Steps already taken in standardization of public health training," by Dr. J. A. McLaughlin, U. S. Public Health Service, and "The course in public health and hygiene for medical students," by Dr. D. E. Edsal, of Harvard University. These addresses will be discussed by Dr. John Sundwall, of the University of Michigan, and by Dr. E. O. Jordan, of the University of Chicago. The closing address, "Education of the partly trained sanitarian now employed," by Dr. W. F. Sears, of Syracuse University, will be discussed by Dr. E. G. Williams, state health officer of Virginia, and Dr. W. S. Rankin, state health officer of North Carolina.

At a joint meeting of faculty members of the plant pathology departments of Washington State College and the University of Idaho the Inland Empire section of the Pacific division of the American Phytopathological Society was formed. The officers elected were: Dr. F. D. Heald, of Washington State College, *president;* C. W. Hungerford, University of Idaho, *vice president;* J. M. Raeder, University of Idaho, *secretary-treasurer.* Twenty-six representatives of the two institutions were present. The program given by the University of Idaho representatives consisted of papers by Dr. Henry Schmitz, associate professor of forest products; Dr. V. H. Young, professor of botany and plant pathology; C. W. Hungerford, plant pathologist experiment station; and J. M. Raeder, assistant plant pathologist.

A press dispatch from Oklahoma City states that an amendment prohibiting the purchase of books or copyrights teaching the theory of the evolution of the human race was inserted in the State Free Text Book Bill which passed the lower house of the legislature on February 21. Only one dissenting vote was cast against the anti-Darwinian section.

A subscriber to Science writes: "As the American Association for the Advancement of Science has definitely adopted evolution and as Science is the oficial *(sic)* organ of the American Association for the Advancement of Science you may discontinue my subscription I have no use for evolution and can not see how any inteligent *(sic)* person can have."

The Wyncote Bird Club, of Philadelphia, held a special meeting on January 23 to hear an address by Mr. R. R. Logan, president of the American Antivivisection Society. Following the lecture an open discussion was held in which Mr. Ernest H. Baynes defended vivisection. At the close of the discussion the society adopted the following resolutions:

Resolved, That it is the sense of this club that Mr. Logan has entirely failed in his attempt to show that vivisection is immoral and unethical and unnecessary to the welfare of human beings or of animals, and, be it further

Resolved, That we heartily endorse Mr. Ernest

Harold Baynes on animal experimentation and sane humane education in general.

The University of Chicago Board of Trustees announces that Professor R. A. F. Penrose, Jr., of Philadelphia, has again contributed five hundred dollars to help provide the full eight issues during the year of the *Journal of Geology*, which he writes is "undoubtedly the best geological journal to be found anywhere."

A gift of £5,000 by a donor, who at present wishes to remain anonymous, has been received by the Rowett Research Institute for Animal Nutrition at Aberdeen. This sum is intended to found a library and to provide for making statistical records.

The Board of Trustees of the American Medical Association has made the usual appropriation to further research in subjects relating to scientific medicine and of practical interest to the medical profession, which otherwise could not be carried on to completion. Applications for small grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before March 15, when action will be taken on the applications at hand.

The United States Civil Service Commission announces an examination to be held on March 21 to fill a vacancy in the position of meteorologist in the Signal Service at Large, U. S. Army, McCook Field, Dayton, Ohio. The entrance salary, depending upon the qualifications of the appointee, will range from $2,240 to $3,000 a year. The appointee will be expected to conduct independent research work along various meteorological lines which will include making, computing and recording meteorological observations. The examination consists of practical questions in physics, mathematics and meteorology and a rating on education, training and experience. The commission also announces an examination for aid in the Division of Marine Invertebrate Zoology, on March 7, for a vacancy in the National Museum, Washington, D. C., at $1,200 a year. Appointees whose services are satisfactory may be allowed the increase granted by Congress for the present fiscal year of $20 a month. The examination is open to men and women.

We learn from *Nature* that the annual exhibition of scientific apparatus organised by the Physical Society of London and the Optical Society was held on January 3 and 4, at the Imperial College of Science, South Kensington. Mr. W. Gamble lectured on "Reproduction of color by photographic processes," and Professor E. G. Coker on "Recent photo-elastic researches on engineering problems. The lectures were illustrated by experiments. More than fifty firms exhibited apparatus and a number of experimental demonstrations had been arranged. Invitations to attend the exhibition were given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London and the Röntgen Society.

Sir Kenneth D. Mackenzie, Bt., presided on January 3 at a meeting of scientific men held at Burlington House, at which it was decided to form a Scientific Expeditionary Research Association. He said that its object would be to facilitate and promote scientific research by means of expeditions to all parts of the world. Societies and institutions not endowed with funds to enable them to dispatch research expeditions had usually to depend on public subscriptions, but an association of this kind could make itself responsible for raising the necessary money. It would have an advisory council composed of members of the councils of all the scientific bodies interested in or affiliated to it. It had been decided to organize a research expedition to the South Pacific Ocean, to start in the early summer and last about ten months. Representatives of the societies concerned would be taken on this trip, and a limited number of fellows of the association interested in science, who might desire to avail themselves of this opportunity for private study, would be permitted. He suggested that the cost would be close on £45,000.

Germany's greatest user of coal is the Federal Railway, which formerly was able to utilize only 55 to 70 per cent. of its combustible material, the remainder (cinder and ashes) having been regarded as worthless. In order to make use of this waste, which is said to contain 50 per cent. or more combustible material, about two years ago the railway adopted the Meguin system of recovering coal from ashes. According to a report by the United States consul at Frankfort on Main, thirteen large works, with a capacity for handling 420,000 tons of cinders and ashes annually, are now in operation or under construction. The amount of pure coke obtained is estimated at 164,000 tons, with an average calorific value of 5,500 units, compared with 7,000 units for good hard coal. The fine coke, with the addition of fine coal and hard pitch, is used in making briquettes, about 74,000 tons of coke briquettes being thus obtained, with a calorific value of 6,500 units. In addition to this, 256,000 tons of non-combustible clean slag are obtained; this serves for the manufacture of 130,000,000 slag stones, which are employed in building.

WILLIAM HENRY HUDSON, the British author and naturalist, writer of "British Birds," and numerous other works on natural history, whose death on August 18 at the age of eighty years has been reported in SCIENCE, left an estate of the gross value of £8,225. The testator directed that all his MSS., notebooks and letters, and any scraps of written paper (unless specially marked for publication, in which case they are to be offered first to his publishers, Messrs. J. M. Dent and Sons) should be destroyed, and after providing for a number of legacies to friends, amounting in all to about £500, the residue of his property is left to the Royal Society for the Protection of Birds, to be utilized in accordance with the terms of a paper writing dated March 31, 1921, deposited with his will, and reading as follows: "The money I leave to the Royal Society for the Protection of Birds is to be used exclusively for the purpose of procuring and printing leaflets and short pamphlets suitable for the reading of children in village schools. The leaflets are to be composed more or less on the lines of those I have written for the society; each is to be illustrated with a colored figure of a bird, the writing is to be not so much "educative" or 'informative' as 'anecdotal.' This, I find, is the easiest way to attract the child's attention to the subject. The colored picture, the story told, excite that interest in and love of the birds which leads to their protection. I think the society should print two or three leaflets of this kind each year, if not more. For the first year or two the interest on the money must suffice, afterwards the capital may be used as required. But I have the hope that the capital may be added to by-and-by by others, so that these publications, which I think are peculiarly well suited for distribution on Bird and Tree Day to all the schools taking part in this festival, may be kept up for an indefinite period."

A CORRESPONDENT to the London *Times* writes: "An illustration of the great difficulty which scientific societies are experiencing in finding money for the publication of memoirs as the result of the increased cost of printing was contained in the presidential address delivered by Major P. H. Hepburn at the annual general meeting of the British Astronomical Association. Major Hepburn said that the Variable Star Memoir, containing a large number of observations made by members of the Variable Star Section of the association from 1914 to 1919, had been ready to print for the past year. It would cost about £400. Towards this sum individual members had promised £175 and the association had earmarked £100. It was hoped that it would be found possible to put the printing of the memoir in hand before the end of the year. It may be added that Professor H. H. Turner and several well-known continental and American astronomers have urged the early publication of this memoir, which will form a continuation of the quinquennial series published since the beginning of the century by the association. In order to accumulate funds for the purpose it has been necessary to postpone publication of memoirs on other subjects. The work of the Variable Star Section has achieved international recognition for the accuracy of the material it provides for the study of the light fluctuations of long period variables."

WE learn from the London *Times* that after an interval of two years the *Botanical Magazine* has made a reappearance under the auspices of the Royal Horticultural Society, for whom Messrs. Witherby have just published Part I of a new volume (148). But slight alteration has been made in the form of the magazine, and the familiar engraving of the Palm House at Kew Gardens occupies its accustomed place on the front cover. The plates in the new part are the work of three artists, and, in general, their execution exhibits a welcome improvement on that of those in the last few volumes of the old set. There is, too, a more liberal allowance of space for the letterpress relating to the various plates, of which the number in each volume is to remain at forty-eight. The unofficial relations which have existed for so long between Kew and the *Botanical Magazine* have not been altogether severed, as, under the new régime, the editing is in the hands of Dr. Stapf, late keeper of the herbarium at Kew. The *Botanical Magazine* appeared without a break since its first appearance in 1787 till the completion of volume 146.

UNIVERSITY AND EDUCATIONAL NOTES

UNDER the will of Mrs. Alice H. Plimpton, who died in Norwood, recently, $50,000 is donated to Harvard University, of which $30,000 will go to Harvard College and $20,000 to the medical school.

TRINITY COLLEGE, Hartford, Connecticut, has received a bequest of $100,000 by the will of the late George E. Hoadley. This brings the amount collected for the Trinity centennial fund to $650,000.

IN connection with celebration of the eighty-fifth anniversary of its founding, which took place on February 22, DePauw University has started a project to raise one million dollars for endowment and a half million for buildings and equipment.

THE Agricultural School of the University of Cambridge will receive through the Ministry of Agriculture and Fisheries £30,000 from the development commissioners to provide for a chair of animal pathology. On the professor being appointed, he would be required to prepare a scheme for the development within the university of the study of the diseases of farm animals. For an approved scheme the commissioners would be prepared to find a capital sum of about £25,000 for buildings, the sites to be provided by the university.

DR. ROBERT E. VINSON, president of the University of Texas, will succeed Dr. Charles F. Thwing as president of Western Reserve University.

DR. R. A. PETERS, lecturer in biochemistry in the University of Cambridge, has been elected to the Whiteley professorship of biochemistry in the University of Oxford.

DR. RAFFAELE ISSEL, son of the late Professor Arturo Issel, the geologist, has been appointed professor of zoology in the University of Genoa.

DISCUSSION AND CORRESPONDENCE

DESTRUCTION OF THE POLARIZATION OF RESONANCE RADIATION BY WEAK MAGNETIC FIELDS: A NEW MAGNETO-OPTIC EFFECT

THE earlier studies of the resonance radiation of mercury vapor in exhausted quartz tubes by one of the present writers showed no traces of polarization, even when the exciting light was polarized. Recent experiments by Lord Rayleigh apparently indicated that polarization existed in that part of the excited column at some little distance from the window at which the beam entered, in other words when the excitation was produced by light from which the core of the 2,536 line had been removed by absorption. This observation was not verified in experiments made by one of us last spring and published in a recent number of the *Philosophical Magazine*. The polarization was found to be strong and of uniform percentage right up to the window at which the beam entered.

On commencing a further study of the phenomenon we found it impossible to produce as strong polarization as was indicated by the earlier experiments, and after varying the conditions in every conceivable manner we finally found that the disturbing factor was the magnetic field of the earth, the polarization rising to a very high value (90 per cent.) when the magnetic field of the earth was compensated by a large solenoid carrying a feeble current. In the absence of the solenoid the percentage of polarization dropped to fifty or less. This appears to be a new magneto-optic effect, and is manifested only when the magnetic field is parallel to the magnetic vector of the exciting light and perpendicular to the beam of exciting rays. A field of only five or six times the strength of the earth's field practically destroys the polarization. Discrepancies found previous to the discovery of this effect were due to the fact that in some cases the apparatus faced north and south, and in others east and west. Lord Rayleigh's observation was doubtless due to the stray field of the electro magnet which was used to flatten the discharge against the wall of his quartz lamp.

R. W. Wood and
Alexander Ellet

The Johns Hopkins University
January 31, 1923

RATE OF MOVEMENT IN GLACIERS OF GLACIER NATIONAL PARK

In consequence of letters sent to the U. S. Geological Survey, I send you the following note for publication:

I have hoped at some time to be able to make some careful measurements of the movement of the glaciers in Glacier National Park, as this is a matter of interest to all the tourists, but I do not know of any such that have been made thus far.

Measurements of Ice Movement in Grinnell Glacier, August 26 to August 30, 1920

No.	Aug. 26, Markers set	Distance	Aug. 26, time remeasured	Distance	Time elapsed	Distance ice moved
1	12:37 P.M.	66⅞ in.	4:13 P.M.	66¾ in.	3 hrs. 36 min.	⅛ in.
2	12:53 P.M.	50 in.	4:06 P.M.	50 in.	3 hrs. 13 min.	0
3	1:02 P.M.	35¼ in.	4:03 P.M.	35 in.	3 hrs. 1 min.	¼ in.
4	1:15 P.M.	28¾ in.	4:00 P.M.	28½ in.	2 hrs. 45 min.	¼ in.

	Aug. 30 time remeasured	Distance	Time elapsed	Distance ice moved
1	2:45 P.M.	65⅞ in.	4 d. 2 hrs. 8 min.	1 in.
2	3:00 P.M.	48 in.	4 d. 2 hrs. 7 min.	2 in.
3	3:00 P.M.	32 in.	4 d. 1 hr. 58 min.	3½ in.
4	3:10 P.M.	24 in.	4 d. 1 hr. 55 min.	4¾ in.

In my pamphlet on Glaciers of Glacier National Park (published by the National Park Service, 1914) I described (p. 6) some very crude measurements which I made in 1913 on Blackfeet Glacier, on Sperry Glacier (p. 15), on Chaney Glacier (p. 35), and on Vulture Glacier (p. 39). In August, 1920, I made similar crude measurements on Grinnell Glacier. Starting at the moraine on the north margin of the lower front of the ice I set spikes in the ice at four places along the frontal edge of the glacier and carefully measured the distances to marks made on the adjacent exposed bedrock directly in front. No. 1 was at the moraine where no bedrock was exposed, so a rock marker was set up. No. 2 was just south of the point where the main creek issued from below the ice. No. 3 was some distance farther north, and No. 4 near the ice cave which was then near the middle of this lobe where there was no moraine. The markers were set between 12:30 and 1:15 P.M., August 26, 1920, and the distances were measured at 4 to 4:13 P.M. of the same day. Again on August 30, after four days, mostly of chilly, rainy and snowy weather, I remeasured the distances with the results shown in the accompanying table. At No. 1, the spike had then fallen out of the hole in the ice but was stuck back in and the distance measured. At No. 2, the spike, though still in the hole, had tipped over so that the measurement is only approximately correct. The apparent movement on the bright sunny afternoon of August 26 ranged from 0 to ¼ inch, time ranging from 2¾ hours to 3 hours and 36 minutes. The total movement in time ranging from 4 days, 1 hour and 55 minutes to 4 days, 2 hours and 8 minutes, ranged from 1 inch to 4¾ inches. It is interesting to note that, as would be expected, the movement, small as it is, is increasingly greater from the side to the middle of the most advanced part of frontal lobe.

These measurements are of course too crude to form a basis for estimating the average daily or annual rate of advance of the ice, yet I think they are of some interest.

Wm. C. Alden

SODIUM IODIDE IN TABLE SALT

To the Editor of Science: No comment seems necessary regarding the importance of traces of iodides for the well-being of the human body. As iodine is a permanent constituent of several human organs the iodides must be regarded as an essential food material.

Lack of iodine causes pathological changes which may become typical of certain geographical regions where local drinking water is devoid of iodides. The regular supply of the extremely small traces of iodine required by humans is easily and simply accomplished by a stroke of the pen: a food law requiring that common table salt contain a trace of iodides. In the manufacture of table salt, either from sea water or salines, iodides are present in the raw material and the incorporation of a trace of them into the sodium chloride requires no additional cost and presents no additional difficulty. By a slight change in the technic of crystallization the danger of iodine starvation would be thus eliminated once for all.

INGO W. D. HACKH

AN ENTOMOLOGICAL ANTIQUE

RECENTLY the California Academy of Sciences has received through the kindness of Colonel John R. White, superintendent of the Sequoia and General Grant National Forests, and Mr. Joseph D. Grant, member of the board of trustees of the academy, a section of an eleven-foot log of the Big Tree *(Sequoia gigantea)* from the Giant Forest, Tulare County, California. On examining this section I noticed that the tree of which this was a section had been struck by lightning about twelve hundred years ago and had then become infested by the larvæ of some wood-boring beetle. Later the tree had grown over the infested area and completely covered it with a growth of healthy normal wood, thus completely sealing up the work of the beetles. It occurred to me if I could secure some of this infested wood I might discover the dried remains of some of the beetles and thus be enabled to compare them directly with the same species as now found in this forest and learn if any change had occurred in the species during these twelve hundred years. I therefore went at once to the Giant Forest and through the kind assistance of Colonel White and his efficient helpers was able to secure a number of pieces of the infested wood from this portion of the log. On examining these in the laboratory I dug out two fairly complete specimens of *Trachykele opulenta* Fall, one shriveled larva of the same and the remains of two hymenopterous parasites associated with them. Later these specimens of the beetles were compared very carefully by Dr. E. C. Van Dyke and Mr. H. E. Burke with specimens of the same species in Mr. Burke's collection which were recently taken in the same forest and on the same species of tree now living there. The result of this comparison reveals the fact that this species has undergone no appreciable change during these twelve hundred years. This species is somewhat variable, but Mr. Burke has specimens that agree in every detail with the fragments taken from the log.

Some details regarding this redwood tree may be of interest. It started as a seedling in the year 217 A.D. When 421 years old it was struck by lightning, stripping the bark and burning the wood for a width of about one foot down the length of the trunk. This burned area became infested by the *Trachykele* larvæ and was mined to a depth of about two inches. The tree at once began covering the wound with a new growth of wood and this process was completed in about fifty years, since which time the work of the beetles has been hermetically sealed within the heart of the sound living tree. A period of 1,279 years elapsed from the injury to the tree, and probably first infestation of the beetles, until the tree fell in 1917. As these beetles must have been dead in their galleries before being sealed by the growth of the tree they certainly represent the species as it was more than twelve hundred years ago. It must, of course, be recognized that *Trachykele opulenta* pertains to an archaic type, perhaps the most primitive of our Buprestids, and undoubtedly the characters of the species had become well fixed long before the Christian era. In some more plastic group the results of such a comparison might have been very different. I should add that when it fell this tree was sound to its roots, that these beetles were taken from a point about forty feet from the ground level, and that I was able to follow the work of the insect for a distance of about fifty feet up the trunk beyond this point by the sawing of the log during the past summer.

EDWARD P. VAN DUZEE

CALIFORNIA ACADEMY OF SCIENCES

AYMARA TYPE OF HEAD DEFORMATION IN THE UNITED STATES

THE "Aymara" type of head deformation was produced by the application of pressure by a circular band passing over the forehead and under the occiput in the newborn infant. It was practised extensively by the Aymara people of Peru and Bolivia, radiating from the Andes to the west coast, towards Chile, and up to the Atlantic coast in Argentina.

A deformation of the same fundamental type, but somewhat different in details, was practised so far as hitherto known in only one spot in North America, namely on Vancouver Island; no specimens bearing plain traces of it were ever recorded or known of from any other part of the northern continent.

In 1919, the U. S. National Museum received from Mr. M. C. Long, of Kansas City, Missouri, an adult female skull which had been found alongside the Missouri River "in riprap work" along the Missouri-Pacific tracks, near Lexington, Missouri. This skull, which is considerably mineralized, presents unmistakable traces of a moderate circular frontal compression, with a medium bulge above this compression, a secondary broad post-coronal depression, and some flattening of the lower part of the occiput—in other words a characteristic form of a moderate "Aymara" deformation.

On January 17, this year, the National Museum received from Mr. R. S. Knowlson, of Kansas City, the remains of a female Indian skull found under an overhanging cliff and in front of the entrance to a small cave near Noel, Missouri. This skull, which is not mineralized, shows also plain traces of a moderate "Aymara" deformation. The grade and type of the deformity are much like those in the skull from Lexington. Both differ in secondary details from the type found in Vancouver. Noel is about 180 miles south from Lexington.

The two skulls may precede in age the late prehistoric and historic Indians of Missouri, who practised no deformation. It would be premature to speculate on their identity; their discovery, however, in these regions is highly interesting and may prove of importance.

ALEŠ HRDLIČKA

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.

SCIENCE AND COMMERCIALIZED ATHLETICS

PROBABLY no member of the American Association for the Advancement of Science will dissent from the opinion that it is at times desirable to scrutinize the use of words and titles in common use and to attempt to follow their legitimate meanings and implications.

Is our "Association for the Advancement of Science" a passive or an active one? Is it restricted or comprehensive in its policy? Is it superficial or fundamental in its scope? What is the meaning of "advancement" as an object of its existence?

In this connection "advancement" means to me six things: first, improvement of environmental conditions for scientific work (anywhere and everywhere); second, increase in the number of competent scientific workers; third, increase in the usefulness (beneficial results) of science to the whole people; fourth, increase in the influence of science in human affairs; fifth, accumulation and intelligent use of funds for scientific purposes; sixth, promotion of mutual aid and mutual understanding amongst scientific workers in all lines with a view to substantial unification of the scientific world.

Again and again in the past twenty years some scientist (not to mention many other people) has recorded a protest against the growing menace of *commercialised* athletics in our educational institutions. Such protests have appeared in various scientific publications as well as in other places and many of them have also been delivered before scientific meetings. In SCIENCE for May 19, 1922, appeared a masterpiece of such protest from the pen of Professor Edward G. Mahin of Purdue University. I suppose that every member of our association knows the truth of his assertions and that almost all endorse his very moderate views and conclusions.

As a matter of fact Professor Mahin distinctly understated the case in two ways. In the first place he did not make distinct the point that the ordinary student is frequently or constantly harassed by demands for money for the use of the parasitic or predatory sporting element and that he is even more frequently disturbed by demands upon his time for "rooting" and other "support of the team."

That is to say, Dr. Mahin did not make it clear that from the moment they enter college most students are under drastic coercion tending to destroy their initiative, break their spirit and bring them into dull submission to destructive interests.

In the second place Dr. Mahin gave no attention to the bad condition in schools below university or college grade. Matters are bad enough *in higher institutions*, but, in truth, the mischief is often done before a youngster reaches college. He is discouraged by the outspoken contempt of the parasite for the "grind." He is impressed by the success of the bluffer or shirker supported by the sporting group. He is intimidated by the bluster or actual physical and social injury of the special interests in his school. He is made suspicious of the motives of other people. He is deprived of the poise and self-confidence so necessary in a good scientist. He is disgusted at the constant demand for money to support those creatures whom he knows to have no interest in either the school or in education.

I charge that the American Association for the Advancement of Science is derelict in its duty and false to its aims so long as it shuns active opposition to such evils. I also consider the association unscientific in its procedure when it tries to add to a superstructure while neglecting to repair its decaying foundation.

Dr. Mahin has clearly stated the ways in which *commercialized* athletics makes bad environment for scientific work. Most of us know cases in which science has been deprived of a competent scientific worker because of its evil influence. Every one of us can find evidence immediately at hand showing that *commercialized* athletics is conducted in open and contemptuous disregard of physical and mental hygiene. It is also true that *commercialised* athletics hinders accumulation of resources for scientific work and particularly diminishes the rewards of the scientific worker.

So much for the relationship of unhealthy amusement to "Advancement of Science." Personally I am intensely interested in the fact that the boy or girl who wishes to get a maximum of scientific training on limited resources is *coerced* into paying varying amounts of money and time and energy to the support of the socially and educationally and scientifically destructive activities of the sporting fraternity.

Individually or collectively 10,000 scientists ought to be able to exert a wholesome influence in these matters, not only for the good of science but for the welfare of our country. In fact it is disgraceful that such appeals as that of Dr. Mahin do not bring *action* as well as silent approval.

W. E. ALLEN

THE SCRIPPS INSTITUTION
FOR BIOLOGICAL RESEARCH

METHODS OF THE CARNEGIE INSTITUTION

TO THE EDITOR OF SCIENCE: President Pritchett's lamentations regarding the woes of the administrators of great benefactions are perhaps the natural reaction of a kindly, just and generous man who, in the nature of things, has to say "no" more often than he can say "yes." When the Carnegie Institution was first founded I wrote the following to SCIENCE (1902, xvi, 484):

> The scholarships should be allotted to laboratories the heads of which have shown themselves competent to do research work. It is a mistake to compel men, who are presumably competent, to reveal an outline of the subject to be investigated. The greatest discoveries are often accidental observations made by trained minds. The former product of their laboratories or of their personal work should be the criterion. In this way, if one line of investigation seems fruitless, the scholar can at will be turned in another course. Thus, the Carnegie Institute may endow but not control the course of science in San Francisco. There must be no limitation to the *akademische Freiheit*.

Consider one example in which this plan was followed, the endowment of the work of Osborne and Mendel, which resulted, among many other discoveries, in our knowledge of the production of xerophthalmia when butter fat is eliminated from a diet otherwise complete, and of its cure by administration of cod-liver oil or of butter fat itself. The two workers were individual scientists, one a university professor, the other a chemist in a state agricultural station. The money was conferred because it could be productive. The men were trusted absolutely. There were no conditions, no red tape, no general uplift organization with strict rules and regulations for conduct, no publicity department, no puffing, no visiting detectives, no superior intelligence to tell them what they ought to do. They were simply left alone to do as they thought best, and they did so. "By their fruits ye shall know them."

It seems to me that the Carnegie Institution is to be greatly congratulated on the methods of its work.

GRAHAM LUSK

TINGIIDÆ

MR. PARSHLEY (SCIENCE, Vol. LVI, p. 754) credits me with too much. I can not lay claim to any "novel idea." And I wish here to state only three facts.

First: Words like Aphiidæ have been used for a long time. See Aphiidæ, "Traité d'Entomologie Forestière," Barbey, 1913.

Second: We are here concerned not with Latin usage and with professors' opinions but with the International Rules of Zoological Nomenclature.

Third: Article 4 of these rules simply states that *idæ* is to be added to the stem. No latitude is given us. It is the writer's humble opinion that any desired modification or interpretation of this article should be made by the International Commission and not by an individual.

A. C. BAKER

BUREAU OF ENTOMOLOGY

SCIENTIFIC BOOKS

The Cactaceæ: Descriptions and illustrations of plants of the Cactus family. By NATHANIEL L. BRITTON and J. N. ROSE. Vol. III. Carnegie Institution Publication No. 248. 1922.

What Professor Wheeler irreverently calls silo and saleratus botanists, and doubtless others, often sniff in private over "the futility of spending fortunes in monographing the Cactaceæ," or any other group of plants. Whiffs of such sedition occasionally reach the outside world, but scarcely penetrate the costly shrines wherein such deeds are accomplished. It is not the purpose of this review to make the appearance of the third sumptuous volume of this greatest of modern monographic ventures either the occasion, or the excuse, to fan into a breeze the undeniable zephyr of discontent that comes from botanists who feel that a great deal too much money is being spent on them. And they are unquestionably costly, as rumors of fourteen thousand dollars spent for illustrations alone on this third volume amply testify—not to speak of the still greater cost of exploration, cultivation of specimens and years of study. So that each of these four volumes, judged by a botanical gauge of wealth, costs a fortune, and by any gauge the four of them are perhaps the most expensive of any recent botanical publication.

The completion of this volume, however, with its twenty-four gorgeously colored plates and two hundred and fifty half-tones, does make a good occasion to reiterate that the enterprise is one that only modern conditions could have produced. For in the hurly-burly of the modern educational and scientific world, the three things that can produce such a work are hard to find, and to find them together is all but a miracle. They are knowledge and the opportunity to increase it, time and money. The authors supplied the first, bringing to their work long experience, and having, in the equipment of the New York Botanical Garden, unexampled opportunity to increase it. Freedom from the rush to produce "research" as a manufacturer might produce a foundry was made possible by the far-sighted policy of the Carnegie Institution in providing sufficient money over a long period of years. The whole enterprise is one where cooperation between great institutions and individuals, willing to sink institutional or personal aims for the sake of the work, has been a conspicuous success.

As to the botanical merit of the volumes, specialized journals will no doubt report upon that in due season. All the botanical world knows that the authors are the greatest living students of the Cactaceæ, and their studies have led them into every part of North and South America, to which the group is practically confined. As something over half a million square miles of North America is a desert country, the necessity of knowing pretty accurately the cactus constituents of this flora is obvious. These volumes are, therefore, the foundation upon which all ecological, phytogeographical and physiological work on desert cacti must be based. And in spite of gentle zephyrs of doubt, such as were noted above, the logic of their preparation and the excellence of the product must be as great a satisfaction to their collaborators as the volumes are undeniably a great contribution to botanical literature.

Norman Taylor
Brooklyn Botanic Garden

SPECIAL ARTICLES

THE CYTOLOGY OF VEGETABLE CRYSTALS

While studying the mucilage cells of cacti, chiefly *Opuntia* spp., I noted the occurrence of calcium oxalate druses both in these cells and in the ordinary parenchyma cells of pith and cortex. The wording of my description[1] exposes me to criticism as to the correctness of my observations, if Professor Jeffrey's views, as expressed in a recent issue of this journal,[2] are found to be well founded. As to this, however, I venture to express doubt, and therefore oppose my own observations to those of Professor Jeffrey.

He states that in "ginkgo," the "Juglandaceæ, Cactaceæ, Begoniaceæ, Geraniaceæ, etc.," the druses (spheroidal aggregates of calcium oxalate crystals) are formed by the laying down of "crystals . . . about the nucleus, when the protoplasm of the element is still dense and unvacuolated." "The crystals in fact constitute a spiny casing which surrounds the nucleus and protoplasm." "The nucleus is therefore central to the crystal itself. Corresponding to this fact there is only one druse in each cell." My own observations lead me to the following results:

The growing buds of ginkgo are indeed very favorable material, the young leaves especially. I have had no difficulty in finding young cells in which minute druses, in diameter less than one third that of the nuclei, could be seen lying in the protoplasm, there being at this time only small sap vacuoles, or none. If a vacuole is present, the druse is usually not found lying free within it and I think it doubtful if a druse ever originates in the sap vacuole, free from the protoplasm. On this point it must be conceded that the current texts do not speak convincingly, while some of the illustrations (*e. g.*, Frank's, see Stevens, "Plant Anatomy," p. 206) are, I think, a bit too diagrammatic, if not fanciful. As the druse increases in size it may come to occupy the greater portion of the total volume of the cell, when the nucleus may be seen crowded against the cell wall and between projecting crystals of the druse. There may then be no sap vacuole recognizable, the druse being clothed with dense protoplasm, with the nucleus as described. Later, in many cases, the protoplasm disappears so that a large druse may then be seen surrounded only by a thin cell wall which has never acquired the thickness of the walls of the living neighboring cells, and which also separates from them more or less. On treatment with hydrochloric acid, the middle of the druse is dissolved more readily than the peripheral larger crystals, and if the action of the solvent is stopped, so as to make the identification of the druses still unequivocal, one can then see some granular material, derived, I believe, from the druse, but which does not stain as protoplasm. Sometimes small flocks of material, staining as protoplasm, may be seen, probably relict of the once living protoplast. I conclude that there is some colloidal material imprisoned within the druse, and this may be essential in conditioning the growth of a crystal aggregate—as the mucilage of raphide cells may do also—but that this colloidal material is the protoplast occupying the central portion of the druse I deny. Accordingly, it is no matter of surprise to find two druses in a cell—though Professor Jeffrey appears not to have found this to be the case. This happens occasionally in narrower cells, in which the nucleus may be seen; it may happen ensconced between two druses. These latter may be of the same, or different—even widely different—sizes. When very small, the projecting crystals may not be easily distinguishable.

The granular, colloidal material above referred to can be seen in many of the larger druses even before treatment with acid, and appears to have a more or less radiating form. This it may be is the material regarded by Buscalioni (*vide* Tunmann, "Pflanzenmikrochemie," p. 139) as mucilaginous.

At any rate the presence of some such material within or intimately associated with the crystalline mass has already been observed; but whether there is a specific body which serves as a center of crystallization is an open question. I have found examples of druses which display both radial and superficial symmetry of structure, centering upon a stainable mass, which, by virtue of these features, strongly incline one to attach importance to an idea of organization which, however, lacks the support of general observability and so becomes insubstantial. It is certainly probable that *something* furnishes a "nucleus" (I here use the physical term) for radial crystallization. The most frequent origin of the druse is in the cytoplasm, and it would appear that in the absence of such a "nucleus," a minute vacuole containing oxalic acid would serve, if calcium were available. It is infrequently that one finds a druse free in a large vacuole, however, and one inclines to the former view, especially when the structure of "rock candy" is recalled, and the string which serves as the "nucleus" for crystallization. Even when druses are formed in cells with very extensive vacuolization, such as the mucilage cells in the cacti, one finds most usually that they are held in the cytoplasm, and do not lie free in the vacuole. It is therefore rather more than likely that, when this does occur, it is secondary, the druse having been thrown out into the vacuole.

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[1] *Amer. Journ. Bot.*, 6, 156-166, April, 1919.

[2] E. C. Jeffrey: "The Cytology of Vegetable Crystals," Science, N. S., 55, 566-567, May 26, 1922.

Professor Jeffrey further points out as a "surprising fact" that under the influence of the protoplast included within the druse the cell wall grows in size to accommodate the growing crystal. In opposition I venture to submit my observation that the shape of the druse is within limits determined rather by that of the enclosing cell wall, and can show preparations in which long crystals have grown into the more roomy end of the cell, while only short ones are found where their ends would more quickly impinge upon the cell wall. When cells which have died are observed, the cell wall, which, as above said, is thin, separates from the adjoining cell walls and collapses more or less, thus coming to form a closer investiture, conforming to a greater or less degree to the contour of the crystalline surface. Definitively, protoplasm has disappeared, and with its crystal ceased. But assuming the fact to be such as Professor Jeffrey asserts, his call of disappearance, growth in the cell wall and attention to the serious problem of the growth of the cell wall removed from immediate contact with the protoplast seems supererogatory. The variously elaborate investitures of spores and analogous bodies supply examples of such difficulty which the mechanistic mind can not, nor, I believe, desires, to minimize.

I have spoken above only of ginkgo. I find, however, nothing in the Cactaceæ, Orchidaceæ, Iridaceæ, Begoniaceæ or in any other material at all out of harmony with what I have found there. In the begonias, in particular, one may find in the calcium oxalate containing cells not merely druses, but various conditions ranging to single crystals. Although it is well known that "inclusions" may occur in crystals, such would be easily enough demonstrable. Here it may be added that by breaking open the large druses, cytoplasmic inclusions if present would be readily exposed to stains. But preparations made in this way, as well as by partial solution by acids, have equally yielded nothing to substantiate the views of Professor Jeffrey.

Of course, any attempt to discuss the problem of the origin and mode of growth of crystals in living cells would involve many more facts than those connected merely with the druse; and the particular contribution of the living substance is the matter above all in which we are interested. In spite of the implications of Professor Jeffrey's concluding remarks directed at the mechanists, it still remains legitimate to use what we do know to attempt to explain what we do not. For example, it is permissible to argue that the mucilage of raphide cells, because of its emulsoid character, furnishes a suitable nidus for the growth of acicular crystals, and it is quite possible that appropriate experiments *in vitro* would show that such crystals can be produced thus. The exceedingly long raphide cells in the petals of *Œnothera* suggest strongly that a capillary glass tube filled with a suitable emulsoid might furnish the mechanism required, but until some one succeeds in doing this, we may permit ourselves to marvel at the living mechanism, so long only, however, as this attitude does not paralyze experimental effort.

FRANCIS E. LLOYD

McGILL UNIVERSITY

BACTERIAL SPOT OF COWPEA

A rather destructive bacterial disease of cowpeas characterized by spots on the leaves, stems and pods has been noted in Indiana since 1919. On the leaves the spots are irregularly circular and one to three millimeters in diameter with a maroon border and buff center. The lesions are not noticeably delimited by the veins. Young lesions are greasy and watersoaked. On the pods the spots are irregularly circular, one to eight millimeters in diameter, and maroon in color, often with a sunken center and a watersoaked border. Early infection may cause a constriction of the pod and stunting of the distal portion. Seeds under pod lesions may be stunted, shriveled or discolored. Dark red, elliptical to linear, sunken lesions are formed on the petioles and stems. In addition to lesions on cotyledons, first leaves, hypoctyls and epicotyls, localized vascular infection and partial wilting may occur among seedlings grown from infected seed.

Numerous isolations and successful inoculations have proved that the disease is due to an apparently undescribed species of bacteria which may be briefly characterized as follows:

Bacterium vignæ, n. sp.[1]

Cylindrical rods, rounded at ends, solitary or in pairs; individual rods 1.5 to 2μ by 0.5μ; motile by 1 to 5 polar flagella at one or both poles; ærobic; no spores; no capsules. Gram negative; most readily stained with gentian violet.

Superficial colonies on potato agar, round, smooth, shining, raised, pulvinate, or umbonate; finely granular, often showing a concentric pattern, grayish white in reflected light, slightly greenish fluorescent in transmitted light.

Gelatin rapidly liquefied; casein digested and no acid produced in milk; nitrates not reduced; no gas with various carbohydrates and no acid except for small amount with dextrose and saccharose; starch not hydrolized.

Growth and greenish pigment formation in Fermi's and Uschinsky's solutions. No growth in Cohn's solution. Slow liquefaction of blood serum and Loeffler's blood serum.

Growth inhibited by 5 per cent. sodium chloride. Growth in +12 and −15 broth and in p_H 4.8. Greenish pigment formation in alkaline broth.

Thermal deathpoint, 50° C. Killed by one hour's exposure to sunlight. Slowly killed by freezing in water. Quickly killed by desiccation on glass, but very resistant to desiccation on cowpea seeds.

Group number, 211.2322033.

Pathogenic on *Vigna sinensis* (L.) Endl.

The disease is seed borne and may be avoided, it is believed, by using seed from disease-free pods. A more detailed account of this disease is forthcoming.

Max W. Gardner
James B. Kendrick
Purdue University Agricultural
Experiment Station

A REVOLUTION RECORDER

In Volume 2 of the *Anatomical Record*, 1908, I described an apparatus for recording the activity of small mammals. In that apparatus the number of revolutions of the cage was recorded in hours, minutes and seconds by a clock. The task of converting thousands of readings of the clocks into their equivalent numbers of revolutions has been so tedious and time consuming that a new device which gives the number of revolutions at reading has been substituted for the clocks.

This device consists of a gas meter index so modified that successive dials have a ratio of 1 to 10. A new dial (10, figure A) has been introduced and the drive gear on shaft "1" has been changed to make the ratio 1 to 10. The two figures A and B show the front and back view respectively. A ratchet wheel (R, figure B) with ten teeth is attached to the shaft of dial 1. The two pawls (P and p) are so weighted (w) as to keep them in contact with the ratchet wheel. A stop (s) prevents the pawls from being thrown completely off the ratchet wheel. The long arm of the lever (L 2) (not shown in the figure), which rests on the axle of the revolving cage, is lifted each revolution by a rod on the end of the cage. This

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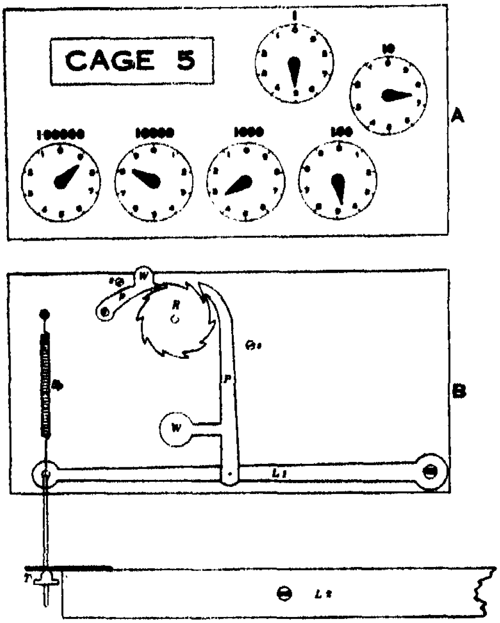
[1] According to Migula's classification and the revision adopted by the committee of the Society of American Bacteriologists (Winslow, C.-E. A., Broadhurst, Jean, Buchanan, R. E., Krumwiede, Charles, Jr., Rogers, L. A., and Smith, G. H.: "The Families and Genera of the Bacteria," *Jour. of Bact.*, 5: 191, 229, 1920) the combination would be *Pseudomonas vignæ* n. sp.



causes a downward pull of the lever (L 1) to which pawl (P) is attached, the ratchet wheel is turned the distance of one tooth, and the hand on dial 1 moved one space. A spring (Sp.) lifts the lever (L 1) to its former position after lever (L 2) has returned to the axle of the cage. The number of revolutions made by the cage are thus automatically recorded in figures which can be read at a glance.

Our revolving cages were equipped with these counters about a year ago and we have found them very satisfactory and a saving of much valuable time.

J. R. Slonaker

Stanford University

THE AMERICAN MATHEMATICAL SOCIETY

The fiftieth regular meeting of the Chicago Section of the American Mathematical Society, being the eighteenth regular western meeting of the society, was held at Northwestern University, Evanston, Illinois, on Friday, December 29, 1922. The meetings were presided over by Professor Coble, chairman of the section, relieved by Professors Curtiss and Dickson. The following papers were presented. The paper by Professor Moore was presented by Mr. Wilder; the papers of Professor Jackson, Dr. Camp, and the first paper of Professor Chittenden were read by title:

Ruled surfaces with generators in one-to-one correspondence: E. P. Lane, University of Wisconsin.

Some theorems on continuous curves, with special reference to continuous curves that contain no simple closed curve: R. L. Wilder, University of Texas.

An analysis of the point-set which constitutes the boundary of a complementary domain of a continuous curve: R. L. Wilder.

An uncountable non-dense closed point-set each of whose complementary intervals abuts on another one at each of its ends: R. L. Moore, University of Texas.

Closed sets of rational points on a plane cubic curve of genus one: Mayme I. Logsdon, University of Chicago.

Report on a boundary value problem of fourth order: H. T. Davis, University of Wisconsin.

The extension of the Weddle and Kummer surfaces to hyperelliptic three-ways of genus three: A. B. Coble, University of Illinois.

Associated sets of points: A. B. Coble.

The rational linear algebras of maximum and minimum ranks: L. E. Dickson, University of Chicago.

A new simple theory of hypercomplex integers: L. E. Dickson.

Symmetric forms in n *variables:* Arnold Dresden, University of Wisconsin.

A general class of problems in approximation: Dunham Jackson, University of Minnesota.

Abstract group definitions and applications: W. E. Edington, Purdue University.

On an infinite system of non-abelian groups of order nm^n: W. E. Edington.

On an infinite system of non-abelian groups of order nm^{n-1}: W. E. Edington.

Note on a property of abstract sets which admit a definition of distance: E. W. Chittenden, University of Iowa.

The Schmidt linear differential forms of a limited bilinear form in infinitely many variables: E. W. Chittenden.

On a form of the property of Borel-Lebesgue which is independent of the closure of derived classes: E. W. Chittenden.

Concerning an expansion in the restricted problem of three bodies: K. P. Williams, University of Indiana.

Expansions in terms of solutions of partial differential equations: C. C. Camp, University of Illinois.

Arnold Dresden,
Secretary of the Chicago Section

SCIENCE

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THE PHYSICAL BASIS OF LIFE[1]

I HAVE been much honored by the invitation to speak on this occasion, but for me it has meant more; for the man in whose memory the Sedgwick Memorial Lectureship has been established was my life-long and cherished friend. My theme to-day is drawn from an infinitesimal but all-including world, bounded by the horizon of the compound microscope, a world that may seem far distant from Sedgwick's own broad domain of sanitary science and the public health. I am sure, however, that such would not have been his own view; for Sedgwick was one of the pioneer teachers of general biology in this country, and it was his life-long habit to think of the phenomena of life in terms of the activities of protoplasm.

I have a lively recollection of how he and I, in the days of our youth, when fellow students at Yale, fell under the spell of Huxley's Edinburgh address on the "Physical basis of life," at that time still a subject of widespread popular discussion. In this celebrated discourse, delivered in 1868, the eminent English biologist set forth certain general conclusions concerning protoplasm which had gradually taken shape through the work of such investigators as De Bary, Max Schultze, Kühne, Brücke and Lionel Beale. Huxley's presentation of the subject was a masterpiece, both of English style and of philosophical breadth of outlook. In part for this reason, still more because of its supposed materialistic implications, it aroused immediate and widespread public attention. Huxley himself warned that to accept his conclusions would be "to place one's foot on the first rung of a ladder which in most people's estimation is the reverse of Jacob's and leads to the antipodes of heaven"; nevertheless, he insisted that he was individually no materialist but on the contrary believed materialism to involve grave philosophic error. Despite this disclaimer, his conclusions aroused a storm of criticism and protest which came to a climax a few years later when Tyndall, in the famous Belfast address, proclaimed his faith in non-living matter as offering the "promise and potency of every form of terrestrial life." Huxley's heresy of sixty years ago has become an orthodox platitude to-day; but the problems of protoplasm still hold us fast with a gripping interest that has lost nothing of its force with the flight of time. In what light do Huxley's conclusions appear after the biological progress of half a century?

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[1] The first Sedgwick Memorial Lecture, delivered in Boston, December 29, 1922. It will hereafter be published in fuller form, with illustrations, under the auspices of the Department of Biology and Public Health, Massachusetts Institute of Technology.

It is necessary to bear in mind that those conclusions were formulated before modern cytology had been born, and long before the cell had been clearly thought of as a colloidal system. From our present point of view we employ the word protoplasm as a collective term to designate the substances that constitute the active or living materials of which cells are composed. I use the plural form, substances, advisedly; for it is here in the first place that Huxley's statements now require recasting in more modern terms. To many readers his discussion conveyed the impression that protoplasm is a single chemical substance or "living protein." In his opening words he speaks of the physical basis of life as "some one kind of matter common to all living beings." He pictures a union of lifeless substances, such as water, ammonia and carbon-dioxide, to form "the still more complex body, protoplasm"; and the properties of this substance, he affirmed, must result from the nature and disposition of its molecules. "The thoughts to which I am now giving utterance," said Huxley, "and your thoughts regarding them, are the expression of molecular changes in that matter of life which is the source of our other vital phenomena."

In one sense, no doubt, these words are true; but evidently they do not express the whole truth. Long ago it became perfectly plain that what we call protoplasm is not chemically a single, homogeneous substance. It is a mixture of many substances, a mixture in high degree complex, the seat of varied and incessant chemical transformations, yet one which somehow holds fast for countless generations to its own specific type. The evidence from every source demonstrates that the cell is a complex organism, a microcosm, a living *system*. With the microscope we distinguish in this system a clear ground-substance or *hyaloplasm* in which are suspended a great variety of formed bodies, widely diverse in form and function, each of which plays its own particular part in the activities of the system. Examples of these are the nucleus, the cytoplasmic chondriosomes and plastids; the Golgi-bodies and central bodies, and many kinds of granules and fibrillæ. Some of them seem to be permanent, others to be transitory formations that come and go in the kaleidoscopic operations of cell-life. Which of them are alive? Which, if any, constitute the physical basis of life? What, in other words, is protoplasm?

These are embarrassing questions. One of the most pleasing functions of the teacher of elementary biology is to demonstrate to the laboratory student the substance of a living cell and assure him cheerfully that he is beholding protoplasm; and by good luck it rarely occurs to the disciple to cross-examine his master on the subject. Were it otherwise, how many a bad quarter of an hour might we have to endure! For the truth is that the more critically we study the question the more evident does it become that we can not single out any one particular component of the cell as the living stuff, *par excellence*. Of this fact most experienced cytologists, including such eminent leaders as Flemming, Strasburger, Bütschli, Kölliker and Heidenhain, long since became convinced. "No man," said Flemming, "can definitely say what protoplasm is . . . In my view that which lives is the entire body of the cell." It is this view of the physical basis of life that has impressed us more and more as our knowledge of the cell has advanced; and this is as true of the physiologist and the chemist as of the cytologist. I quote a distinguished biochemist. "We can not," says Professor Hopkins, "without gross misuse of terms, speak of the cell life as being associated with any particular type of molecule. Its life is the expression of a particular dynamic equilibrium which obtains in a polyphasic system. Certain of the phases may be separated, but life is a property of the cell as a whole, because it depends upon the equilibrium displayed by the totality of coexisting phases." This conclusion is in substance precisely the same as that of the cytologist.

I repeat, therefore, that when we speak of protoplasm as the physical basis of life, we mean simply the sum total of all the substances that play any active part in the cell life; and we can not, I think, exclude from the list such substances as water and inorganic salts which we commonly think of as "lifeless." At first sight this may seem a rather barren conclusion; but the fact is quite otherwise. No conception of modern biology offers greater promise of future progress than that the cell regarded as a whole is a colloidal system, and that what we call life is, in the words of Czapek, a complex of innumerable chemical reactions in the substance of this system. Modern investigation has indeed already profited so much by the point of view thus offered as to suggest that the study of protoplasm and the cell may be destined to pass more and more into the hands of the physiologist, the physicist and the chemist. In any case the rising tide of cell-research in these directions is of good augury for the future experimental analysis of vital phenomena. There are, however, other aspects of the problem which still escape the precise quantitative methods of the physicist and chemist, or are only beginning to come within their range, but none the less are essential to our view of the general problem. I refer to those phenomena with which the cytologist, the embryologist and the geneticist must try to deal; and it is especially to this side of the question that I here ask attention.

The cytologist is first of all struck by the extraordinary pains that nature seems to take to ensure the perpetuation and accurate distribution of the components of the system in cell-division, and hence in heredity. Nothing is more impressive than the demonstration of this offered by the nucleus of the cell; but its obvious meaning has often been disregarded or treated with a blind scepticism which pretends that no meaning exists. To our limited intelligence, it would seem a simple task to divide a nucleus into equal parts. The cell, manifestly, entertains a very different opinion. Nothing could be more unlike our expectation than the astonishing sight that is step by step unfolded to our view by the actual performance. The nucleus is cut in two in such a manner that every portion of its net-like inner structure is divided with exact equality between the two daughter-nuclei; and the cell performs this spectacular feat with an air of complete and intelligent assurance. The nuclear substance is spun out into long threads or chromosomes; these are divided lengthwise into exactly similar halves; they shorten, thicken, separate and pass to opposite poles; and from the two groups formed are built up two daughter-nuclei, while the cell-body divides between them. In outward appearance such a process seems to contradict all physical principles, but its meaning has now become perfectly plain. In a general way it means, as Roux pointed out forty years ago, that the nucleus is not composed of a single homogeneous substance, but is made up of different "qualities" or components; and it means that these components are strung out in linear alignment in the threads so that they may be divided and distributed in a particular manner through the longitudinal doubling of the threads.

This conclusion led the way in a series of investigations that have brought forth some of the most notable discoveries of our time. The direct cytological evidence of a serial alignment of smaller bodies along the nuclear threads has thus far indicated the fact in only a somewhat rough and ready fashion, showing hardly more than the fact that the nuclear threads may often be seen to contain smaller bodies or "chromomeres" aligned in a single series, and sometimes showing definite size-differences. It seems certain, however, that this visible structure is no more than the rough expression of a finer one that lies beyond the reach of the microscope; and fortunately genetic experiment has here come to the rescue with indirect evidence on a grand scale, derived from experiments on the mechanism of Mendelian heredity. This evidence was brought forward mainly by Morgan, Sturtevant, Bridges and their coworkers in their widely known studies on heredity in the fruit-fly *Drosophila*, an object which offers unparalleled opportunities for extended and accurate experiment owing to the readiness with which it can be bred under standardized conditions, the remarkable speed of its development, and its frequent production of heritable mutations. I regret the necessity that limits my reference to this remarkable work to a bare indication of its most general results. It has brought a final demonstration of the fact, established in a more general way by earlier observers, that the nuclear threads or chromosomes seen during cell-division play an essential part in the process of hereditary transmission. It has removed every doubt that the Mendelian phenomena may be fully explained by the behavior of the chromosomes or their components (as was first indicated in a more general way by Sutton, Boveri and DeVries).

It has brought overwhelming confirmation of the correctness of Roux's conception of the nuclear threads as linear aggregates of specifically different smaller entities of some sort, we know not what. For all this we had in some degree been prepared by earlier researches; but what now follows seems at first sight, I confess, completely incredible. The evidence drives us on to the conclusion that even the smallest details of heredity depend upon the behavior of infinitesimal units or "genes," far more minute than the chromomeres, strung out in linear series in the nuclear threads, each of its own specific kind and self-perpetuating by growth and division. It has made clear the fact that in the conjugation and disjunction of these bodies lies the ultimate explanation of Mendel's fundamental law. And, finally, in the midst of our struggles to assimilate all this, we are dealt a final blow with the remorseless demonstration that these units must be of definite number, separated by fairly definite and constant intervals, and *arranged in a definite and invariable serial order!* When we try to reckon with this series of demands, we find ourselves fairly gasping for breath. Such results are indeed staggering—to a certain type of mind even harder to believe than those which physicists are now asking us to accept concerning the structure of atoms. Nevertheless, *they are probably true!*

It is necessary to emphasize the fact that these conclusions did not arise in the fertile imagination of a Bonnet, a Buffon, or a Weismann. They are the product of concrete and extended experiments under carefully controlled conditions; they have made possible precise and quantitative prediction; and the data can be confirmed by laboratory experiment almost as readily as those with which the physicist or the chemist has to deal. In these respects they are comparable in validity with many of the concepts of physical science. It is possible, I suppose, to consider such conclusions as nothing more than a convenient fiction or algebraic symbolism, a kind of ideal model by means of which the genetic facts may conveniently be grouped. Those, however, who prefer to take their point of departure in the observed cytological facts will be more likely to make use of the actual model which every dividing cell displays to us in visible reality—a model that is not less impressive because at present the cytologist sees it only in broad outline with no more than dim indications of the finer complications inferred from the results of genetic research. And in point of fact it was this actual model from which came the first suggestions for the foregoing conceptions, and thus made possible some of the most important experimental researches on heredity in our time. Even if considered only as working instruments, therefore, these conceptions have a practical value almost comparable to that of the atomic theory as employed in chemistry and physics.

Cytology and genetics have thus combined to make real to us the existence of an organization of the nuclear region of the cell-system that is as complex and wonderful as any pictured by the fantasy of the speculative nature-philosophers. But we can not rest content with this demonstration. Inevitably we are led on—perhaps I should say led back—to the question whether an organization of similar type, or in any degree approaching to such a type, may also exist in the cytosome or extra-nuclear region of the cell-system. Conservative cytological opinion has been extremely reluctant even to recognize such a possibility. We have been too prone to take the cytoplasmic region of the cell-system, so to speak, at its face value; too ready to think of it as a vague and formless mass devoid of definite organization, or organized only by the domination of the nucleus. We have long been accustomed to think of the history of the cytosome as a simple mass division in fundamental contrast to the complicated meristic process seen in nuclear division. Facts are, however, slowly accumulating which may compel a revision of this notion. Recent cytological studies bring prominently into view the fact that many of the formed bodies are directly transmitted either as such or in the form of pre-existing specific material from mother-cell to daughter-cell.

Vague indications of such a conclusion were long since given by the plastids of plant-cells, which are certainly in many cases, perhaps in all cases, self-perpetuating by growth and division without loss of their identity, though their distribution to the daughter-cells during division often seems to be an irregular or quite incidental process. At a later period it was demonstrated that the centrioles or central bodies, which form the foci of mitotic cell-division, are often self-perpetuating by a similar process, but in this case are handed on in a perfectly definite manner from cell to cell during division. More recent cytological studies raise the question whether still other formed bodies may not show a similar behavior. This question has not yet been definitely answered, but evidence has been coming in which places under suspicion the chondriosomes and the Golgi-bodies. Both these are in many cases handed on during division from mother-cell to daughter-cell, sometimes segregating with a precision that almost suggests that seen in case of the chromosomes. In many cases the chondriosomes take their place in separate groups about the equator of the karyolinetic spindle, draw apart into corresponding equal daughter-groups, move towards the poles and enter the respective daughter-cells. Whether these bodies individually considered have a permanent identity and are self-perpetuating by division is still a disputed question. Undoubtedly they are sometimes actually cut in two during cell-division; and in one well-determined case (spermatocytes of the scorpion *Centrurus*) all the chondriosomes become aggregated into a single ring-shaped body that is accurately divided in the course of the ensuing division. Often, it is true, the chondriosomes seem to be passively sorted out or segregated into two approximately equal groups; but in all these cases the possibility remains open that they may multiply by division at an earlier period. Were such the case their history in division would be comparable to that often seen in case of the plastids of plant-cells; and in point of fact an important group of observers, headed by Meves and by Guilliermond, have concluded from direct cytological observations that plastids may arise by the transformation of chondriosomes. If this should prove to be correct, substantial ground would be given for the conclusion that the chondriosomes may multiply by division since the plastids undoubtedly have this power. Still less is known of the Golgi-bodies in this regard; but recent studies have clearly shown that these bodies, too, group themselves in a definite manner about the mitotic spindle during cell-division and separate into two distinct groups which pass into the two respective daughter-cells.

Doubtful or disputed points aside, it already seems clear that in a large class of cases the specific substances of which the chondriosomes and Golgi-bodies are respectively composed are not formed *de novo* in the daughter-cells, but are somehow directly derived from corresponding components of the mother-cell. It is now certain, further, that in some cases their segregation in the daughter-cells can not be regarded as a merely passive or mechanical result of mitosis but is determined by a more definite and significant relation between these bodies and the centers of division; for as has recently been demonstrated by Bowen the chondriosomes are sometimes definitely oriented with respect to the centers in a manner that almost suggests that which characterizes the behavior of the chromosomes. In all this we see surface indications of a more deeply-lying process by which the complex cytoplasmic system may perpetuate itself intact from one generation to another or, by a modification of this process, may split up into secondary more limited systems according to a definite and predetermined plan. This will become clearer when we take a broader survey of the origin of the cytoplasmic formed bodies in general, a problem which now opens before us with a new significance.

It is possible that some, perhaps many, of the visible formed bodies are transmitted from mother-cell to daughter-cell in the form of chondriosomes, possibly also of Golgi-bodies, which are later transformed into bodies of more differentiated types. An important group of observers have in fact advocated such a conclusion; but its validity still remains in doubt. On the other hand it is a widely prevalent view that many of the formed bodies arise *de novo,* being built up anew in the hyaloplasm by localized processes of chemical and morphological synthesis; but in respect to this question we may readily fall into error. Permit me to illustrate this by reference to some old observations of mine on those classical objects for the study of protoplasm, the transparent eggs of certain sea-urchins and starfishes.

When mature these eggs show with great beauty a structure somewhat like that of an emulsion, consisting of innumerable spheroidal bodies suspended in a clear continuous basis or hyaloplasm. These bodies are of two general orders of magnitude, namely, larger spheres or *macrosomes* rather closely crowded and fairly uniform in size, and much smaller *microsomes* irregularly scattered between the macrosomes, and among these are still smaller granules that graduate in size down to the limit of vision with any power we may employ. It is probable that both macrosomes and microsomes may be of several, perhaps many, different kinds; but this may here be disregarded.

The important fact here to be emphasized is that this so-called "alveolar" structure is not a primary characteristic of this protoplasm. It is of secondary origin, arising by the appearance in the homogeneous ground-substance of extremely minute scattered bodies which by growth and crowding together finally produce the emulsion-like structure. In the middle stages of this process the protoplasm gives an interesting picture. When viewed under a relatively low magnification, *e. g.,* 300-500 diameters, only the larger bodies are seen; but as step by step we increase the magnification, step by step we see smaller and smaller bodies coming into view, at every stage graduating down to the limit of vision. This remains true even with the highest available powers. The microscopical picture offered by such protoplasm is thus somewhat like the telescopic picture of the sky. At each step in the improvement of the telescope new and fainter stars have come into view. At each step the astronomer has felt sure that still more powerful telescopes would bring into view stars hitherto unseen. The cytologist is equally sure that if the present limits of direct microscopical vision could be extended we should see disperse bodies still more minute; and the invention of the ultra-microscope has in fact made us directly aware of the existence of suspended protoplasmic particles too small to be seen directly by the ordinary microscope, but made evident by their halos when viewed by the ultra-microscope in powerful reflected light.

In these eggs the smallest dispersed visible particles give us the impression that they are formed *de novo* in the structureless ground-substance. But manifestly it is illogical to affirm an origin *de novo* of any formed body because it first becomes visible at a particular enlargement, even the greatest at our present command. Here, clearly, is an enormous gap in our knowledge. All the available data—I can not here review them—indicate that below the horizon of our present high power microscopes there exists an invisible realm, peopled by a multitude of dispersed particles, a realm that is quite as complex as the visible one with which the cytologist is directly occupied. And the evidence further indicates, apart from all controversies concerning the nature of the so-called colloidal solutions, that many of these bodies are of much greater dimensions than the molecules of even the most complex organic substances.

We have now arrived at a borderland where the cytologist and the colloidal chemist are almost within hailing distance of each other —a region, it must be added, where both are treading on dangerous ground. Some of our friends seem disposed to think that the cytologist should here call a halt and hand over his inquiry to the chemist and the physicist with a farewell greeting. The cytologist views the matter somewhat differently. Unless he is afflicted with total paralysis of his cerebral protoplasm he can not stop at the artificial boundary set by the existing limit of microscopical vision. He is rudely pushed forward by the impact of a series of stubborn facts with which he must somehow try to reckon. He can not get out of his head that microscopical picture of progressively diminishing magnitudes which, as if viewed through an inverted telescope, disappear at last in vanishing perspective in the sub-microscopical depths. At the nearer end of this vista are the plastids, larger or smaller, each of its own specific type, and self-perpetuating by growth and division. A step beyond are the central bodies, often of such minuteness as to lie almost on the horizon of microscopical vision, but still capable of self-perpetuation by growth and division, of enlargement to form much larger bodies, and of exerting far-reaching effects on the surrounding structures. One more step and the cytologist is beyond the help of the microscope, wandering blindly in an unseen but none the less real world. The pathologists tantalize him with visions of disease-germs which no eye has yet seen, so minute as to pass through a fine filter, yet beyond a doubt self-perpetuating and of specific type. The geneticists continually crowd upon him with fresh demonstrations of those unseen somethings aligned in orderly array in the nuclear threads, each preserving its own specific type amid all the shifting events of the nuclear life, without modification by its fellows, and somehow, generation after generation handing on its individual characteristics to its descendants.

With all this in mind the cytologist finds reason enough to exercise his wits upon the apparently structureless ground-substance or hyaloplasm that seems to constitute the fundamental basis of protoplasm and to be the source of many of its formed elements. He can not resist the evidence that the appearance of a simple, homogeneous colloidal substance offered by the hyaloplasm is deceptive; that it is in reality a complex, heterogeneous or polyphasic system. He finds it difficult to escape the conclusion, therefore, that the visible and the invisible components of the protoplasmic system differ only in their size and degree of dispersion; that they belong to a single, continuous series, and that the visible structure of protoplasm may give us something like a rough magnified picture of the invisible. The cytologist is led still further to the conclusion that the ultra-microscopical dispersed particles of the hyaloplasm may be as highly diversified chemically as are the visible formed bodies, and that they are of all orders of magnitude; further, that it is they which constitute the sources, or at least the formative foci, of those larger formed bodies that we have so often but erroneously assumed to arise *de novo*. For my part, I am disposed to accept the probability that many of these particles, as if they were submicroscopical plastids, may have a persistent identity, perpetuating themselves by growth and multiplication without loss of their specific individual type. And lastly, there are many facts made known especially by experimental embryology, which indicate that it is in the apparently structureless hyaloplasm that the real problem of the cytoplasmic organization lies; and the same facts drive us to the conclusion that the submicroscopical components of the hyaloplasm are segregated and distributed according to an ordered system.

I am tempted to a larger development of this subject with reference to the problem of development, but time forbids. Good biological society has of late looked decidedly askance upon all corpuscular or micromeristic conceptions of the cell. To consider them seriously at this day requires a certain amount of courage. By some singular process of casuistry such conceptions have been supposed to place the fundamental problems of biology beyond the reach of scientific investigation. An ingenious philosopher has said that corpuscular hypotheses in general would make of the world—or of the cell—a mere puzzle-picture which we cut up into small pieces only to put them together again to form the same picture. The reply to this gibe, evidently, is the pragmatic one. Modern physical science has cut the whole world up into very small pieces and has thus far seemed to manage fairly well with the pictures rebuilt from them. The fathers of the cell-theory engaged in a somewhat similar operation when they resolved the living body into its component cells. Some of the successors of these pioneers, even down to our own day, have seemed to find something very reprehensible in this conduct; nevertheless, the cell-theory has somehow managed to survive as an effective means of biological progress. Perhaps, therefore, the youthful sciences of cytology and genetics may hope for lenient treatment if they try to go somewhat further along the path marked out by their forefathers. Many earlier hypotheses of this type failed by reason of their too speculative character and because too much was claimed for them, either by their authors or by critics who wished to destroy them. Such was the case, for instance, with Weismann's speculations on the architecture of the germ-plasm, of DeVries on intracellular pangenesis, and of Altmann concerning the general significance of the protoplasmic granules. But we are not here concerned with merely theoretical constructions but with questions of fact that are directly and insistently forced on our attention by concrete microscopical and experimental studies on the cell. It is our business as students of cytology and genetics to answer these questions if we can. And lastly, I would remark that I am not here attempting to resuscitate the old conception of the cell as an assemblage or colony of elementary organisms or primary vital units —perhaps it is such, perhaps not—nor am I able to see how the possibilities here considered are in any manner out of harmony with the conception of the cell as a colloidal system.

We approach the final stage of our inquiry. We have, as it were (to return to Bergson's metaphor), taken the cell to pieces. How shall we put it together again? It is here that we first fairly face the real problem of the physical basis of life; and here lies the unsolved riddle. We try to disguise our ignorance concerning this problem with learned phrases. We are forever conjuring with the word "organization" as a name for the integrating and unifying principle in the vital processes; but which one of us is really able to translate this word into intelligible language? We say pedantically—and no doubt correctly—that the orderly operation of the cell results from a dynamic equilibrium in a polyphasic colloidal system. In our mechanistic treatment of the problem we commonly assume this operation to be somehow traceable to an original pattern or configuration of material particles in the system, as is the case with a machine. Most certainly conceptions of this type have given us an indispensable working method—it is the method which almost alone is responsible for the progress of modern biology—but the plain fact remains that there are still some of the most striking phenomena of life of which it has thus far failed to give us more than the most rudimentary understanding.

The nebulous state in which the whole concept of organization still remains is brought home to us when we attempt to deal with the fact that every organism either is, or at some time has been, a single cell. When it has come to full development the organism consists of coordinated parts, displaying a multitude of cunning devices—anatomical, physiological or chemical—that make provision for the harmonious cooperation of its activities and for its protection and maintenance. To this extent its organization is obvious and intelligible; and to the same extent the organism is clearly a piece of mechanism, a living machine. But let us review the building of this machine by following it backwards, step by step, to its starting point. Step by step we find the intricate machinery of life vanishing before our eyes until nothing remains but a single cell, the egg. In the egg-cell, complex though it may be in its own way, not a trace seems to remain of the coordinating and unifying devices of the adult; but who will maintain that the egg is not as specifically organized and as truly alive as the adult to which it gives rise?

It is an old notion to which modern research has given a certain semblance of support that the embryo is already present in the egg, blocked out, as it were, "in the rough" in the cytoplasm, so that development has only to impress upon it the finishing touches; but there is now conclusive evidence that the rough model, with the more than doubtful exception of one or two of its most general features, is itself the product of antecedent localizing operations of development. The main features of this process, often perfectly evident before the egg begins its cleavage into cells, may in some cases readily be followed by the eye. It is an impressive spectacle that is offered by the egg when busily engaged at its work of blocking out the embryo, without visible tools or model, but with an uncanny air of deliberate purpose and mastery of technique that any human artist might envy.

What then constitutes the organization of the egg? No one is yet able to answer. The embryologist, the cytologist, the physiologist and the biochemist—all of these alike have thus far only skirted the outermost rim of the problem. We can not predict how far the cytologist of the future may be able to penetrate within it; but it would seem that sooner or later his way will finally be blocked by inherent limitations of the microscope determined by the wave-length of light. If we are ever to find our way into the innermost arcanum of the cell other methods must be employed; and we must marshal all the resources of experimental embryology, genetics, biophysics and biochemistry. Experimental embryology has contributed many important discoveries towards elucidating the phenomena of development, but it has also emphasized our failure thus far to solve the central problem. From this source, indeed, came the facts on which Driesch, a distinguished pioneer in this field, based his famous argument against the machine-theory of development and in favor of a new philosophy of vitalism. The rock on which the whole mechanistic conception of organization and development splits, he insisted, is the fact that a *fragment* of an egg may undergo complete development and produce a perfect dwarf embryo. This argument may fail to convince us—it does fail—but no one has yet found an adequate reply to it. All, on the contrary, now points to the essential correctness of Driesch's contention that at the real beginning of development the cytoplasm of the egg is devoid of any structural pattern or machine-like configuration that foreshadows the plan of the future embryo. Not alone the structural details of the embryo but the very plan on which it is built is constructed anew in the course of development.

May we then seek a solution of the puzzle in the nucleus of the egg? Perhaps. It is no longer open to doubt that the development of particular characters somehow depends upon the presence in the nucleus of corresponding particular and separate units; and this conclusion loses nothing of its force by reason of the fact that the precise nature of the units is still unknown. We know from Boveri's celebrated experiments that normal development depends on the normal combination of these units. Genetic evidence is now opening far-reaching horizons of future discovery by the accumulating demonstration that no one of the nuclear units plays an exclusive rôle in the determination of any single character. It has been made clear that the individual unit may affect the production not merely of one character but of many. Conversely the probability is shaping itself that the production of any single character requires the cooperation of several or many units, possibly of all. I believe it is not a great overstatement when I say that every unit may affect the whole organism, and that all the units may affect each character. We begin to see more clearly that the whole cell-system may be involved in the production of every character. How then are hereditary traits woven together in a typical order of space and time? It is the same old puzzle made larger and more insistent but not yet, so far as I can see, brought nearer to its solution. We are ready with the time-honored replies: It is the "organism as a whole"; it is a "property of the system as such"; it is "organization." These words, like those of Goldsmith's country parson, are "of learned length and thundering sound." Once more, in the plain speech of everyday life, their meaning is: *We do not know.*

I do not in the least mean by this that our faith in mechanistic methods and conceptions is shaken. It is by following precisely these methods and conceptions that observation and experiment are every day enlarging our knowledge of colloidal systems, lifeless and living. Who will set a limit to their future progress? But I am not speaking of to-morrow but of to-day; and the mechanist should not deceive himself in regard to the magnitude of the task that still lies before him. Perhaps, indeed, a day may come (and here I use the words of Professor Troland) when we may be able "to show how in accordance with recognized principles of physics a complex of specific, autocatalytic, colloidal particles in the germ-cell can engineer the construction of a vertebrate organism"; but assuredly that day is not yet within sight of our most powerful telescopes. Shall we then join hands with the neo-vitalists in referring the unifying and regulatory principle to the operation of an unknown power, a directive force, an archæus, an entelechy or a soul? Yes, if we are ready to abandon the problem and have done with it once for all. No, a thousand times, if we hope really to advance our understanding of the living organism. To say *ignoramus* does not mean that we must also say *ignorabimus*. I do not believe that a confession of ignorance leaves us with no recourse save vitalism. To maintain that observation and experiment will not bring nearer to a solution of the puzzle would be to lapse into the dark ages. Perhaps Professor Henderson is right when he expresses his belief that organization has finally become a category that stands beside those of matter and of energy. Perhaps there is no problem or none that we can formulate without talking nonsense. Perhaps we should go no further than to record and analyze the existing order of phenomena in living systems without losing sleep over the imaginary problem of a unifying principle. Let us politely salute all these uncomfortable possibilities and go our way. For my part, I find it more amusing to look forward to a day when the great riddle may give up its secret.

EDMUND B. WILSON

DARWIN AND PASTEUR: AN ESSAY IN COMPARATIVE BIOGRAPHY[1]

PLUTARCH'S "Parallel Lives," although read and admired throughout the ages, have found remarkably few imitators. Why this is so would be an interesting question. Perhaps the rise of Christianity, with quintessence of altruism and an instinctive recognition that comparisons, if not necessarily odious, are often unkind, has something to do with it. Perhaps the spirit embodied in that most charitable of pagan maxims—*de mortuis nil nisi bonum*—has also played its part. The modern neglect of Plutarch's method is the more remarkable because it is the basic method of modern science, and the tap root of modern thinking and working. Science owes an immense and growing debt to comparative anatomy, comparative geology, comparative physiology, and comparative pathology. More lately it has produced also the rich fruits of comparative philology, comparative philosophy, comparative politics, comparative psychology, comparative religion and comparative literature. Why not, then, back to Plutarch and the potential field of comparative biography?

Ruminating thus in the blessed quiet hours of a professorial holiday, and braced by the cool airs of an Alpine valley, I could not resist the temptation to revive Plutarch's method by a comparison of the two great master minds of the Victorian era whose labors have thrown upon the mysteries of the living world a clear and penetrating light, a blaze which time may dim but can never extinguish.

Charles Robert Darwin wrought upon the mind of his time a complete change in the point of view concerning the origin, the nature and the relationships of mankind and other living things. Louis Pasteur disclosed to the astonished gaze of the nineteenth century a new world of microscopic life dwelling upon us, within us, and about us, working sometimes for good and sometimes for evil. Darwin was a silent Savonarola, Pasteur a sedentary Columbus of Biology. Such masters invite study and comparison.

To Charles Darwin and Louis Pasteur belongs the rare distinction of having changed completely the point of view of their own and probably later generations.

Nothing had been more interesting or more puzzling throughout the ages than the origin and relationships of the various kinds or species of plants and animals. Dogs, cats and sheep; oaks, elms and willows—how did they come to be so alike, and yet so different? The ancients had their theories, but these were set aside or forgotten in the Christian world when the biblical account of creation came to be literally accepted. That account, like many that had preceded it, affirmed a strictly supernatural origin for plants and animals, and so overcame all difficulties. But by the middle of the nineteenth century the world was growing impatient of supernaturalism, especially in the exaggerated form this had taken on in the Middle Ages, and was ready for a change, so that when Darwin published his great work on the "Origin of Species" in 1859 it was comparatively easy for him to convince his contemporaries that the various kinds of plants and animals (including man) have come into existence gradually and naturally, rather than suddenly and supernaturally. This he did by powerful arguments supported by long chains of evidence for the transmutation of species mainly under the influence of a new principle or natural law which he called natural selection, and Herbert Spencer named the survival of the fittest. The simple supernatural theory had long failed to satisfy the minds of many thoughtful men, but, since these could not discover any other or more reasonable explanation of the great mystery, they either adopted the waiting attitude of agnosticism or else acquiesced nominally and perfunctorily in the current hypothesis. Meanwhile, a way had been paved for the easier acceptance of the Darwinian theory of gradual transmutation by the geologists, some of whom were now teaching that the various features of the earth had come into being slowly and naturally rather than suddenly and supernaturally, and by the archeologists who were finding almost daily evidences of the great antiquity of man and of his low condition in antiquity.

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[1] The accompanying essay was left uncompleted by the late William Thompson Sedgwick of the Massachusetts Institute of Technology, when he died, as we all wish to, quickly and before his work was finished. Such an essay may be not only especially timely in this Pasteur anniversary, but may also be useful at a time when men of faith are attacked by men of ignorance and credulity.—G. J. P.

Hardly less interesting to mankind than his own origin and the origin of other forms of life have been, throughout the ages, the origins of plague, pestilence and sudden death. Those fearful phenomena, however, seemed to our more thoughtful forefathers hardly more mysterious than did swift decay or riotous putrefaction, while the fermentation of wine and beer and bread had long puzzled the wisest. Here, too, in ancient and medieval times, supernatural explanations were invoked, and here also for those who could not entertain such explanations, and for almost everybody by the middle of the nineteenth century, the waiting attitude of agnosticism had come to be the only rational attitude. Almost at the very moment when Darwin startled the world by the publication of the "Origin of Species," that other seer of the nineteenth century, Louis Pasteur, was solving the problems of fermentation, putrefaction and decay which, as he soon discovered, led him straight into the tangled mysteries of contagious and infectious diseases.

Happily, we possess of these two men full and intimate biographies, Darwin's by a son, and Pasteur's by a son-in-law. For Darwin we have also a brief but precious autobiographic sketch, and it is understood that M. Vallery-Radot must have had Pasteur's assistance in his work. None who wishes to feel for himself the spirit of nineteenth century science should fail to peruse these two great biographies. And if, along with these, or after them, he turns to that of Thomas Huxley by his son Leonard, he will be at once instructed, entertained and amused by the life-history of Darwin's great apostle, one of the bravest, brightest, honestest and wittiest of Victorian Englishmen.

Darwin and Pasteur were for sixty years contemporaries, but Pasteur was the younger by thirteen years. Darwin was born in February, 1809, Pasteur in December, 1822. Born thirteen years apart, they died thirteen years apart, both at the age of seventy-four years. The two youths, as things go to-day, were near neighbors, for Paris and London are not now far apart. But when they were boys or young men this was not the case. Napoleon, whose great deeds formed—so Pasteur's biographer tells us—a kind of historical background of glory for the Pasteur family, was at the same time probably thought of with disgust in the Darwin household. France and England had long been hereditary enemies rather than friendly neighbors, and the two boys, though so near, grew up with very different ideals and under different conditions. Both had good parents and good homes, but Darwin's parents were gentlefolk, while Pasteur's were hardworking tradespeople. Darwin's father was a well-to-do practising physician, Pasteur's an impecunious tanner. Darwin's grandfather, Erasmus Darwin, had a strong taste for science, coupled with an imagination which led him to write verses entitled "The botanic garden." Pasteur's father was a veteran of the Napoleonic wars, proud of his loyal service. His grandfather was an unsuccessful tanner. Darwin's mother was Susannah Wedgwood, daughter of Josiah Wedgwood, the successful and famous manufacturer of pottery. Pasteur's mother was Jeanne Roqui, the daughter of a gardener. Through her mother the Pasteurs later inherited some small sum. Pasteur's mother was "very active, full of imagination" and enthusiasm. Of Darwin's mother, who died when he was only eight years old, we know but little, but her grandson says "we may hazard the guess that Charles Darwin inherited from the Wedgwood side his sweetness of disposition, while the character of his genius came rather from the Darwin grandfather."

The schooling of the boys was different. For Darwin it was the regular training of well-to-do English boys, *viz.*, a public school; for Pasteur, the corresponding French training for a poorer boy. For the Darwin family it was much a matter of course; for the Pasteur family a hard struggle nobly conceived and bravely executed. The boys themselves seem to have been not unlike other boys; not very studious, not very appreciative of their opportunities. At that time, no one, probably, would have predicted for either any great distinction above his fellows.

As to religious training we are told but little for either, but we get the impression that while Pasteur was surrounded by an atmosphere of strong Roman Catholic piety, Darwin had the ordinary and conventional religious training of a Church of England family.

In his nineteenth year Darwin is uncertain of his career, giving his father anxiety, and shifting from would-be physician to clergyman. He goes to Cambridge and, though to be a clergyman, drifts into a sporting set which sometimes drinks too much. No word is ever said about the want of money. Pasteur in his nineteenth year has just taken his *bachelier ès lettres* and has become a kind of sub-master in the college of Besançon. He was by this time in deadly earnest—too earnest. Unselfishly and bravely he offers to pay for his sister's schooling, though earning only 24 francs a month.

At 22, when American boys leave college, Darwin begins his real life work—engaging to go on the *Beagle* and giving up medicine and divinity. At 22 Pasteur is in training at the Ecole Normale and teaching his old father science.

At 30, Pasteur is three years married and deep in his researches on the tartrates. At 30, Darwin marries and writes up his *Beagle* Journal, a geologist and recognized as a good man of science but hardly as yet for original work.

At 40 (1849) Darwin is engaged in "the slow journey towards the origin of species." At 40 (1862) Pasteur had studied fermentation of beer and vinegar. Was elected to the Academy and advised by Balard and Dumas to give up crystallography and prosecute his studies of ferments.

At 50 (1859) Darwin published his "Origin of Species." At 50 (1872) Pasteur, like Luther, propounded his theses in the fire of controversy.

At 60 (1869) Darwin is now fighting, too. At 60 (1882) Pasteur is triumphant.

At 70 (1879) Darwin is practically triumphant. At 70 (1892) Pastur is completely triumphant.

Pasteur, more intense, impatient, more enthusiastic, more conscientious, became serious earlier, achieved earlier, married earlier, won distinction earlier, aroused controversy earlier, triumphed earlier, but did not die earlier. Pasteur had better health (the first wealth is health) though once almost killed by overwork.

For both the non-effect of environment.

For both industry, concentration, struggle.

For both natural law in place of mystery.

For Pasteur, minutæ, laboratory, precision.

For Darwin, broad principles, masses of evidence, field work, less laboratory.

For Pasteur, "the infinitely little."

For Darwin, the continuing development of mankind.

Both Darwin and Pasteur were fortunate in bringing out their great ideas at the right time. (Agnosticism in medicine, agnosticism in cosmology). The world was tired of supernaturalism and ready for naturalism. It was tired of confusion and ignorance concerning disease, and eagerly embraced the germ theory.

The fame of Darwin has grown greater with the passing years. Darwinism has already become merged and may one day become submerged in the broader doctrine of evolution, of which it was the forerunner. Pasteur's name, curiously enough, is popularly best known in pasteurization, a process of applied science employed long before his day under other names and no name, but first made rational and scientific by him. But Pasteur's original ideas and discoveries have spread like an infection until to-day they cover the earth.

Darwin, the master of the organic world, sleeps near Newton, the master of the inorganic, in the great Abbey, among the most famous of his race. Pasteur rests alone in the chapel of his laboratory. The world claimed Darwin's body to place among its great ones. Science kept Pasteur's for its own. Both dwell forever among the immortals. The last half of the nineteenth century may well be called their age—the Age of Darwin and Pasteur.

EDWARD EMERSON BARNARD

The death of E. E. Barnard on February 6, 1923, brought to a close a life and a career which were at once among the most notable and the most inspiring recorded in the annals of American science. The loss will be felt almost as keenly in every country where science is cultivated and loved. Here and there in every generation there breaks through the magma of our common clay a man whose mind is lighted and whose will is energized by a ray of genius. Such a man was he. The manner in which Nature chooses her sparking points and brings together the unusual elements of personality which make a marked man is only beginning to be recognized.

The outward circumstances of Mr. Barnard's life are so well known to most readers of Science that recitation of them is barely necessary. Even to himself as he struggled and won there must have come often the thrill of romance. To others, unacquainted with the details of his heroic struggle, he personifies in his life the freedom, the opportunity, the vigor and love of action inherent in our great democracy. Sketches and books will be written about him. No better investment in personality could be made than to render the facts and circumstances of his life and work easily accessible to the boys and girls of our country, whom he loved so well and believed in so fervently.

Mr. Barnard was born in Nashville, Tennessee, December 16, 1857, and died in his home near the Yerkes Observatory in the evening of February 6, 1923. His father died before he was born and his mother in 1884. One brother survives him. His early education was given him by his mother. His work as a boy helper in the photographic studio of the brothers Calvert in Nashville and the loan of Dr. Thomas Dick's book, "The Practical Astronomer," combined to stir his imagination and direct his attention toward the subject which was to become his lifelong and sole passion, astronomy. The acquisition of a five-inch telescope in 1877 led him on in his study of the celestial objects, notably Jupiter. In this year the annual meeting of the American Association for the Advancement of Science was held in Nashville and he became a member. On January 27, 1881, he married Miss Rhoda Calvert, the gentle sister of his employers, whose life became devoted most completely to solicitous care for her husband and whose death came less than two years before his own.

On the morning of May 12, 1881, he found a faint comet in the field with Alpha Pegasi and after observing it again the next morning he telegraphed the discovery to Mr. Lewis Swift, of Rochester, N. Y., a veteran comet-seeker. In spite of diligent search by both of these men, and by others, no further trace of it was ever found. Either just before or after this experience Mr. Barnard began his systematic search for comets and on September 17 he was rewarded by finding the comet which is known as Comet VI 1881. Before he left Nashville to join the newly organized staff of the Lick Observatory on Mount Hamilton in California he had discovered nine new comets. He later found seven more, bringing his total up to sixteen. One of these he found by photography on October 12, 1892, the first ever found in this manner.

His early discoveries and his earnestness and zeal attracted the attention of the chancellor and the instructors of the recently established Vanderbilt University at Nashville. In 1883 he was offered a fellowship at Vanderbilt and was given such sympathetic assistance that by tutoring and studying day and night he was able to graduate in 1887. During this time he was in charge of the university's six-inch telescope. In 1889 he received the A.M. degree of the University of the Pacific, in 1893 the degree of Sc.D. from his alma mater and in 1909 the degree of LL.D. from Queen's University, Kingston.

At the Lick Observatory his association with Sherburne Wesley Burnham cemented a friendship which lasted for life. Mr. Burnham, his senior by nineteen years, was already at that time a famous observer whose kindly interest was reciprocated by the greatest admiration on the part of the younger man. When the Yerkes Observatory of the University of Chicago was organized in the middle nineties, both became professors of practical astronomy on its staff and remained so, Mr. Burnham until he retired in 1914 at the age of seventy-five and Mr. Barnard until his death.

While at the Lick Observatory he continued his visual work on comets and the planets and developed the methods of photographing comets and the star clouds and nebulosities of the Milky Way. Then, on September 9, 1892, he glimpsed the diminutive inner moon of Jupiter, with the thirty-six inch refractor, confirmed his observation on the following nights and in a few weeks he had convinced an incredulous world of astronomers that Jupiter has a fifth satellite which is unique in its location and behavior as well as most difficult to see on account of its close proximity to its brilliant master.

Almost immediately, recognition for this remarkable discovery was given him, when, before the year was out, the French Academy of Sciences voted him the Lalande Medal, following up its growing admiration of his feat by giving him the Arago Medal in 1893. In 1897, formal recognition of this discovery and of his other work came from the Royal Astronomical Society of London in the shape of its gold medal. Later, in 1900, the French Academy again honored him with the Janssen Gold Medal. Then, in 1906, the Astronomical Society of France presented him its Janssen Medal and in 1917 the Bruce Gold Medal of the Astronomical Society of the Pacific was awarded him for his long and notable activity. Only the year before, he had added to his list of discoveries the faint star in Ophiuchus, which has the largest known proper motion, 10.3 seconds of arc a year, and a parallax exceeding half a second of arc. He was a member of the National Academy, the American Philosophical Society and the American Academy of Arts and Letters. Since 1914 he was a trustee of the Benjamin Apthorp Gould Fund and an associate editor of the *Astronomical Journal*.

Like his great friend Burnham a tireless worker, he was most unlike him in the distribution of his efforts. Mr. Burnham concentrated on two allied lines of work, orbital motions and proper motions of stars. Mr. Barnard's published observations encompass every type of object in the sky. While thoroughly philosophic in his method and in his attitude of mind his interest was in discovery and description rather than in theory. His published articles and notes number more than eight hundred and forty. Here, to mention a few, are announcements of comets; positions, photographs and drawings of these fascinating objects, which never ceased to thrill him, and of surface details of the planets; measures of sizes and positions of primaries and satellites; exhaustive light curves of novæ and of variable stars, for one of which, at least, he gave the period to such a degree of accuracy that he was wont to say it could be used as a fundamental clock, in somewhat the same manner that Mr. Michelson's wave-length of the red line of cadmium can be used as the standard of measurement of length; long lists of auroræ with dates and descriptions; discussions of meteoric trails and methods of defining them precisely; discussions of the technique of photography and the performance of lenses; measures of difficult and important double stars like Sirius and Procyon; the parallax of Krüger 60 from micrometric measures; a long series of micrometric measures of position of Eros in 1900-1901; magnificent photographs of terrestrial cloud forms which have found their way into treatises on the atmosphere of the earth; a masterful biographical appreciation of his friend Burnham; photographs and description of the solar corona obtained in the three total eclipses which he observed, in California, 1889, North Carolina, 1900, and Wyoming, 1918;[1] observations of the Zodiacal Light, the Gegenschein, which he discovered independently in 1883, and the luminous night haze. Volume XI of the Publications of the Lick Observatory is made up of his photographs of the Milky Way and of comets taken at Lick and his notes and descriptions of them.

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[1] All his preparations and the longest journey he ever made to observe a total eclipse of the sun were in vain when bad weather obscured the sun at the critical time in the Sumatra eclipse of 1901.

Up to within less than a week of his death, while in bed, he worked with his invaluable assistant, Miss Mary Ross Calvert, upon the text of his "Atlas of the Milky Way" from negatives taken at the Yerkes Observatory and, for some of the more southerly fields, at Mount Wilson during a stay of some months at that observatory in 1905. This atlas, which he had hoped to finish during the present year, will be published by the Carnegie Institution of Washington. His close study of these magnificent photographs led him to distinguish sharply between what he held were vacant spaces in the galaxy and those due to opaque masses of matter lying on the near side of the star clouds. His great series of triangulations with the micrometer on many of the globular clusters were continued for a quarter of a century and will be published in due time. When he began them he expected to find internal motions within a few years, but, as he measured, his universe grew larger and even with the great Yerkes telescope he was able to find the slightest traces of motion only for a very few stars. His one hobby was his orchard, where he fought valiantly and scientifically the pests which would rob him of his fruit. His eye was keenly open to terrestrial nature about him and he never wearied in telling the beauty of the swelling bud, the marvelous structure of the oak ball, the mysterious career of the *Cicada septendicem* or the adaptation of form to mode of life of the lowly chigger.

Observing with a large telescope was to him as a sacrament and with his highly varied program of observation he would persist under atmospheric conditions which compelled other observers to desist. When he lectured, as he did often and well, he was not at ease until he became so completely engulfed in the flow of his presentation that his self-consciousness left him.

More than most men, he was beloved by his fellows for his unselfish charm. We, who have lived with him for many years, miss his light footfall in the corridor, his friendly smile and his charitable counsel.

Astronomy, which gave him his greatest pleasure in life, was herself immeasurably enriched by his restless activity for nearly half a century.

OLIVER J. LEE

SCIENTIFIC EVENTS

THE HABER PROCESS[1]

THE lecture delivered by Professor F. Haber on the award of the Nobel Prize at Stockholm on June 1, 1920, is printed in *Die Naturwissenschaften* for December 8. Professor Haber dealt first with the work done on the synthesis of ammonia before his first research in 1905. Practically nothing of importance had come to light, and the very small yields at ordinary pressures did not hold out much promise of technical application.

The early experiments of Haber, like most of those which have served as the foundations of great industrial undertakings, were made with a purely scientific object, and with no technical applications in view. The results obtained, however, soon made it clear that the basis of an important technical process could be found in ammonia synthesis, and further work was undertaken with this end in sight.

In 1908 the Badische Gesellschaft placed at Haber's disposal all the means requisite for the further progress of the research on the synthesis of nitric oxide in the electric arc which he had begun in 1907, but his proposal to undertake research on the synthesis of ammonia was received with open doubts as to the potential value of the method. The nitric oxide syntheses, in cooled arcs under reduced pressure, and in flames and explosions, were not found suitable for technical application, and attention was then turned to the stone which the builders had rejected. The judgment of the technical chemists of the Badische Gesellschaft had been at fault, since ammonia synthesis was ultimately a very real solution of the problem of the economic utilization of atmospheric nitrogen.

Ramsay and Young in 1884 had found that with nitrogen and hydrogen in presence of iron at 800° C. no ammonia was produced. This was found to be incorrect, and traces of ammonia were detected. Other catalysts were tried, and from the results it was evident that an equilibrium state was attained, from which it was possible to calculate the yields at other temperatures and pressures. No further progress was made, however, since it was judged by the technical experts to be impossible to carry out the reaction on the large scale at the temperatures required under the very high pressures indicated by the calculations.

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[1] From *Nature*.

In 1906 measurements under pressure were for the first time carried out by Nernst and Jellinek (these are not referred to by Haber), and in 1908 Haber in conjunction with Dr. Le Rossignol began experiments at higher pressures. The work of Le Rossignol (a British subject) is spoken of with great approbation, although his part in the achievement of success has perhaps not always received full credit in some quarters. The technical chemists were still unfavorably inclined towards the process, although practical yields had now been reached. By the use of new catalysts the temperature was lowered to 500-600° under a pressure of 200 atmospheres. In 1913 the process was taken up by the Badische Gesellschaft, but an account of the main scientific results was also published. The work of Dr. Bosch speedily led to the successful introduction of the synthetic ammonia process, and in the period 1913-1920 the capacities of the German factories rose from *nil* to 35,000 tons per annum in 1914, 850,000 tons in 1918 and 1,500,000 tons in 1920.

INTERNATIONAL SCIENTIFIC COOPERATION

THREE committees appointed by the Commission on International Intellectual Cooperation of the League of Nations held sessions in Paris at the end of December, namely, the committee on bibliography, the committee on matters pertaining to universities and the committee delegated to study into the question of intellectual ownership.

A report in the *Journal* of the American Medical Association states that the committee on bibliography is engaged in the coordination of bibliographic enterprises undertaken in the various countries, with a view to avoiding duplication of effort and assuring to scientists and investigators the advantages of a complete bibliography easily accessible. The committee on university matters is dealing with various questions relative to the organization of the international congress of universities. The committee, however, recognizes the fact that political conditions will not permit the convening of such a congress at present. But it is possible to take up at once an extended inquiry into the best means of bringing about a cooperation between the universities. Opportunity is offered also for the discussion of kindred questions, such as the publication of an annual catalogue containing a list of all the courses given in the universities of the world, and the creation of a bureau of information pertaining to universities.

The committee on intellectual ownership is studying more particularly the question of the extension of authors' rights in the field of science, so as to secure to the individual scientist and the field of science represented by his country a more adequate participation in the benefits arising from the utilization of his discovery. At present the system of patents protects only the inventor of the industrial application of a scientific discovery. The mathematician, the physician, the chemist and the biologist, whose scientific discoveries made possible the invention, derive no benefit either for themselves or for their laboratories from the utilization of their works. At the instance of the chairman, M. Bergson, the committee delegated M. Ruffini, professor in the University of Turin, to draw up a plan which, subject to the approval of the commission on intellectual cooperation and the council of the League of Nations, might be used to establish the juridical principles for international protection of scientific discoveries. Such a plan might serve later as the basis for drafts of laws which, with the necessary modifications, might be presented to the parliaments of the various countries. With this object in view, M. de Torrès y Quevedo, of Madrid, was designated to study the possibilities of applying, in a practical way, the juridical principles and the suggestions for legislation contained in the document to be drawn up by Ruffini.

RESEARCH SERVICE TO THE INDUSTRIES OF MICHIGAN

UNIVERSITY extension service to the manufacturing and technical interests of the state is being introduced to the Michigan manufacturer through the issuing and distribution of a booklet explaining the purpose and facilities of this special department.

Professor A. E. White, director of this department, has been investigating the problems of the state's industries and his purpose is to put the facilities of the various university laboratories at the service of Michigan manufacturers. Through this service trained specialists in practically all phases of research work will be available to the manufacturer. The large and complete technical library of the university will also be at the disposal of any one having special problems.

It is believed that there is a definite need for a research service of this kind, and that many Michigan industries will avail themselves of the service as in many cases the type of research which is necessary may be conducted only with expensive equipment such as is contained in many of the university's laboratories.

The types of service of this department are of three kinds. The library service, in addition to making available the scientific library, is prepared to make photostat prints, write translations and do other work of a like nature. The second division of the service is for the study of problems requiring an ultimate though not immediate answer. The third is for the investigation of problems which require the full time service of one or more persons for a period of six months or longer. This includes the chemical and physical tests.

The problems which may be studied through the department with the present facilities are grouped under the following specific types of service: aeronautics, automotive equipment, ceramics, design of special machinery, electric transmission and distribution, fuels, heating, ventilating and illumination, hydraulics, machine shop practice, power plants and their equipment, radio and telephony and tests of building and engineering materials.

PUBLIC LECTURES OF THE CHICAGO SECTION OF THE AMERICAN CHEMICAL SOCIETY

THE Chicago Section has launched an aggressive campaign to popularize chemistry by choosing speakers, and by advising various civic, social and cultural organizations in the city that these men and women are willing to talk to them about chemistry. Two letters have been sent out; the first to speakers, advising them as to the best methods of making popular addresses, and the second to organizations which the section believes will entertain the idea of learning some of the modern facts about chemistry. Below is the list of speakers chosen for this work:

G. L. Wendt, Ph.D., chief research chemist, Standard Oil Company of Indiana; former professor of chemistry, University of Chicago.

W. Lee Travis, Ph.D., head of the chemistry department of Northwestern University; developer of war gas known as "Lewisite."

David Klein, Ph.D., technical director at the laboratories of Wilson and Co.; formerly assistant professor at the University of Wisconsin; state chemist of Illinois; specialist in the use of internal glandular extracts in medicine.

Otto Eisenschiml, head of the Scientific Oil Compounding Company: "Chemistry as a career."

Julius Stieglitz, Ph.D., head of department of chemistry of the University of Chicago: "Chemistry in everyday life."

Mrs. L. F. Supple, assistant professor of textile chemistry at Lewis Institute: "The chemistry of cloth."

P. N. Leech, Ph.D., laboratories of the American Medical Association: "Home remedies—their use and abuse."

G. A. Menge, Ph.D., consulting chemist: "Milk—its various available forms and their relative merits."

H. E. Barnard, Ph.D., director American Bakers Institute; formerly state food commissioner of Indiana: "The bread of life—its rôle in nutrition."

I. K. Russell, editor of *Baking Technology;* formerly on editorial staff of the New York *Evening Mail:* "Pasteur, the chemist."

F. L. Dunlap, Sc.D., consulting chemist; formerly associate chief, United States Bureau of Chemistry: "What do we know about flour?"

C. S. Miner, consulting chemist; head of the Miner Laboratories: "The chemist in the courts."

W. D. Harkins, Ph.D., professor of chemistry, University of Chicago: (1) "Radioactivity"; (2) "The building of atoms."

J. A. Hynes, chief chemist of the United States Customs Service at Chicago: "Reminiscences of a customs house chemist."

G. W. Hoover, M.D., chief, Chicago Station, United States Bureau of Chemistry: "Food and drug frauds."

E. H. Volwiler, Ph.D., chief chemist, Abbott Laboratories: "Coal tar in medical science."

W. D. Richardson, chief chemist, Swift and Company: "Vitamines in everyday diet."

L. M. Tolman, chief chemist, Wilson and Company: "Shortening fats and household economy."

J. J. Vollertson, chief chemist, Morris and Company: "The chemist in the packing house."

William Hoskins, consulting chemist; dean of Chicago Chemists; head of Mariner and Hoskins: "Reminiscences of a consulting chemist; snow crystals."

R. E. Doolittle, chief, Central District, United States Bureau of Chemistry: "Food Poisoning."

Katharine Blunt, Ph.D., associate professor, home economics, University of Chicago: "Chemistry in domestic science."

William D. McNally, chief chemist, coroner's laboratory, Chicago: "Chemistry in the coroner's office."

H. N. McCoy, Ph.D., director, Lindsay Light Company; formerly associate professor of chemistry, University of Chicago: "Development of the electric light."

F. C. Whitmore, Ph.D., professor of organic chemistry, Northwestern University: "Organic chemistry and public health."

J. R. Chittick, Pharm.D., chief chemist, Jaques Manufacturing Company; formerly associate professor of chemistry, Highland Park College, Iowa: "Chemistry of baking powders."

R. C. Coleman, chief chemist and general manager Economy Fuse Company: "Chemistry of paints and varnishes."

Max Henius, Ph.D., formerly co-head of the Wahl-Henius Institute: "Chemistry of fermentation."

ORGANIZATION OF SCIENTIFIC MEN IN THE NORTHWEST

In Spokane a meeting of people interested in the advancement of science was held at a banquet at the Davenport Hotel, on the evening of February 9. Thirty-six sat at the table. Representatives from the science faculties at Washington State College, University of Idaho, State Normal School at Cheney, Whitworth College, Spokane University, North Central High School and the Lewis and Clark High School were present besides a number of others. Mr. L. C. Armstrong, secretary of the Columbia Section of the American Institute of Mining and Metallurgical Engineers, presided. Discussion brought out clearly the need of an organization with a meeting center in the northwest. Only nine people from the four northwest states out of an American Association for the Advancement of Science membership of about three hundred attended the Boston meeting. Letters were received from President Evermann and Secretary Sargeant, of the Pacific Division, and Secretary Livingston, of the American Association, as also from Chancellor Brannon and President Clapp, of the University of Montana; President Holland, of Washington State College, and Professor Brode, of Whitman College, who were unable to attend. A committee consisting of Dr. M. A. Angell, of Idaho University; Dr. Frederick Heald, of Washington State College; Dr. Geo. W. Hess, of Whitworth College; Miss Elizabeth L. Martin, of Cheney State Normal School; Superintendent O. C. Pratt, Spokane public schools, and Mr. Frederick Keffer, mining engineer, were appointed to draw up plans for a permanent organization to be reported at the time of the meeting of the Inland Empire Education Association in Spokane the first week in April. Letters have been sent out by the chairman and secretary of the preliminary meeting to a large number of scientists residing in the territory of the "Inland Empire Association" advising them of this committee and asking them to communicate their ideas to the committee on the type of organization which would best serve the interests of this region. Two types were discussed at the meeting: first, a division of the American Association or a section of the Pacific Division; second, an organization of the familiar academy of science type which would furnish a means of publication of matter of a regional nature. An organization combining both features was suggested by Secretary Livingston.

Thomas Large,
Secretary

NEW HAVEN MEETING OF THE AMERICAN CHEMICAL SOCIETY

The sixty-fifth general meeting of the American Chemical Society will be held at New Haven from April 2 to 7.

A symposium on "Motor fuels" will be held jointly by the Division of Petroleum Chemistry and the Section of Gas and Fuel Chemistry. The results of various investigations as to the worth and quantity obtainable of alcohol blends, new methods of producing gasoline from petroleum and natural gas, work in blends of benzol and kerosene and other blends will be reported. Papers will be presented also covering discoveries in regard to anti-knock compounds, more efficient carburetion and other subjects which have a direct bearing on the problem of keeping the supply of motor fuels of all kinds equal to the demand.

The Division of Dye Chemistry has arranged for a symposium on "The coal tar dye industry in the United States prior to 1914." Nutrition will be discussed in the meeting of the Division of Biological Chemistry, which will hold a symposium on that subject. Attempts to isolate and get a better understanding of vitamines will be reviewed. Agricultural chemists have arranged a symposium on "Insecticides and fungicides" at the meeting of the Division of Agricultural and Food Chemistry.

Chemical problems involved in the production of artificial silk paper, gun cotton, smokeless powder, celluloid and pyroxylin lacquers will be discussed in various papers to be presented before the Division of Cellulose Chemistry. This division will deal particularly with recent achievements in the artificial silk industry at a symposium on "Oxycellulose, cellulose hydrate and hydrocellulose." The Division of Rubber Chemistry will honor the memory of Charles Goodyear, who, by his pioneer work on the vulcanization of rubber, made possible the rubber industry to-day.

Among those who have accepted invitations to speak at the general sessions of the society are Secretary of War John W. Weeks and Dr. Francis P. Garvan, president of the Chemical Foundation.

The dedication of the Sterling Chemistry Laboratory, of Yale University, will be held on Wednesday, April 4, at which members of the chemical society will be guests of the university. Chemists of international note who will be present and take part in the dedication exercises and also in the chemical society meetings will be Professor W. Lash Miller, of Canada; Professor G. Urbain, of France; Professor F. G. Donnan and Principal J. C. Irvine, of England; Professor G. Bruni, of Italy; Professor A. F. Holloman, of the Netherlands, and Professor The. Svedberg, of Scandinavia. Professors M. Gomberg, G. N. Lewis and A. A. Noyes, among others, will represent the United States.

SCIENTIFIC NOTES AND NEWS

Dr. Edouard Benjamin Baillaud, director of the Paris Observatory, has been given the Bruce gold medal, awarded by the Astronomical Society of the Pacific. The presentation was made on February 27 by Myron T. Herrick, the American ambassador.

The Nichols medal of the American Chemical Society has been awarded to Thomas Midgley, Jr., head of the fuel section of the General Motors Research Corporation laboratories at Dayton, Ohio. The medal will be presented in New York on March 9 by Dr. C. A. Browne, chairman of the New York section. Professor Wilder D. Bancroft, of Cornell University, will deliver an address on Mr. Midgley and his work. Mr. Midgley will review the effects of anti-knock compounds on gaseous detonation.

At the meeting of the Franklin Institute on February 21, Dr. Lee de Forest received the Elliott Cresson gold medal awarded to him for his invention of the three-electrode audion. In presenting Dr. de Forest for this award, his invention was characterized as one of the most important ever made in the field of the electrical transmission of intelligence and one which through its development has marked a profound revolution in the art of radio communication.

Two hundred members of the California section of the American Chemical Society attended dinner at the Hotel Bellevue, San Francisco, in honor of Professor E. C. Franklin, president of the American Chemical Society. Dr. Carl L. Alsberg, local chairman, presided, and Professor John M. Stillman was toastmaster. Addresses were made by Professors Leuschner and O'Neill, of the University of California; C. E. Grunsky, representing the Engineers' Society, and Dr. Alonzo E. Taylor and William L. Burdick, of Stanford University. Congratulatory letters and telegrams from many educators and chemists were read.

The trustees of the University of Wyoming have passed the following resolution: "Be it resolved, that in recognition of the loyal and efficient service given to the University of Wyoming during the past five years by Dr. Aven Nelson, we, the members of the board of trustees, express our appreciation of his untiring efforts toward the development and growth of this institution, and that we do hereby confer upon him the title of president emeritus of the University of Wyoming." Dr. Nelson is resuming his work as professor of botany.

As a result of the International Engineering Congress in Rio de Janeiro, the following North American engineers were elected to membership in the Club de Engenharia; *Corresponding members:* Josiah E. Spurr, editor of the *Engineering and Mining Journal-Press;* Louis J. Hirt, engineer, Pearson Engineering Corporation. *Honorary members:* Verne L. Havens, director *Ingenieria Internacional;* A. W. K. Billings, Canadian and General Finance Committee, Ltd.; Edward Wegmann, consulting engineer; Samuel M. Vauclain, president Baldwin Locomotive Works; Calvin W. Rice, secretary of the American Society of Mechanical Engineers.

DR. RUDOLPH MATAS, of New Orleans, professor of surgery in Tulane University of Louisiana, has been notified of his election to membership in the Royal Academy of Medicine, Barcelona, Spain. He has also recently been elected a corresponding member of the Société Nationale de Chirurgie de Paris.

THE *Journal* of the American Medical Association reports that Dr. Juan Guiteras is living a quiet, rural life since his retirement from the charge of the national public health service in Cuba. On the occasion of the recent Sixth Latin-American Medical Congress at Havana, the Sociedad de Estudios Clinicos presented Dr. Guiteras with a gold medal as a tribute to his distinguished services to science. The address on the presentation of the medal was by Dr. Vicente Pardo Castello, followed by one of the delegates from Brazil to the congress. They spoke of Dr. Guiteras's work on yellow fever and his trip to Africa in 1916 to study epidemics under the auspices of the Rockefeller Foundation, and especially of his share in reducing the death rate from tropical diseases, not only in Cuba but also throughout the world.

THE Italian Association of General and Applied Chemistry has appointed a committee under the presidency of Senator P. Ginori Conti, to arrange a celebration in honor of the seventy-fifth anniversary of Professor and Senator E. Paternò. As a permanent memorial of the occasion, the committee has decided to establish a memorial fund for the "Paternò medal" which will be conferred annually upon the author of the most important contribution to chemistry, regardless of his nationality. In order that the endowment of this medal may be given an international character, the committee welcomes contributions from the chemists of the world in support of the medal. Subscriptions from American chemists may be forwarded to the Division of Chemistry and Chemical Technology of the National Research Council, Washington, D. C., for transmission to the Italian committee.

A SPANISH journal gives a list of more than one hundred towns in Spain which have renamed a street in honor of Professor Ramón y Cajal. Some have installed large artistic tablets to designate the street.

PROFESSOR HEUBNER, the senior German pediatrician, who for many years was head professor of pediatrics on the University of Berlin Medical Faculty, and who, since his retirement, has been living in a suburb of Dresden, celebrated on January 21 his eightieth birthday.

OWING to a severe illness arising from a wound received during the war in France, Sir T. W. Edgeworth David has resigned his position as president of the Australian National Research Council. His place has been filled by the election of Dr. Orme Masson, professor of chemistry in the University of Melbourne. Professor David continues to serve the council as vice-president.

DR. HUBERT WORK has been transferred from the office of postmaster general to become secretary of the interior, succeeding Albert B. Fall, whose resignation became effective on March 4.

A JOINT resolution has been passed by the Senate and the House of Representatives reappointing Mr. Henry White as a regent of the Smithsonian Institution, appointing Mr. Frederic A. Delano to succeed the late John B. Henderson, and Mr. Irwin B. Laughlin to succeed the late Alexander Graham Bell.

THE Rockefeller Foundation announces that it has elected to its board of trustees Dr. Ray

Lyman Wilbur, president of Stanford University, California, and William Allen White, writer and newspaper editor, of Emporia, Kansas; and to membership on its International Health Board, Dr. David L. Edsall, dean of the Harvard Medical School.

MR. GEORGE W. HOOVER, chief of the Chicago station of the Bureau of Chemistry, has been appointed chief of the newly created Drug Control Laboratory. Mr. M. W. Glover, who has been in charge of the office of drug administration, has been recalled to the U. S. Public Health Service, and Dr. L. F. Kebler, chemist in charge of the Division of Drugs, has been promoted to the position of chemist in charge of special collaborating investigations and will direct the work involved in the enforcement of the Postal Fraud Law.

O. D. STREET, general manager of distribution of the Western Electric Company, has been elected a vice-president of the McGraw-Hill Company. He will have executive charge of *Electrical World, Electrical Merchandising, Journal of Electricity and Western Industry, Industrial Engineer, Electric Railway Journal* and *Bus Transportation*.

DR. H. C. COOPER, formerly in charge of physical chemistry and electrochemistry at the College of the City of New York, has removed to Chicago to become director of the scientific department of Bauer and Black, manufacturers of surgical dressings, etc.

W. F. LANTZ has been appointed chief chemist at the plant of the Bethlehem Steel Company, Bethlehem, Pennsylvania, to succeed A. D. Shankland.

W. D. RICHARDSON, chief chemist, Swift and Company; Paul Budnick, chief chemist, Armour and Company, and L. M. Tolman, chemical director, Wilson and Company, constitute a committee of the Institute of American Meat Packers to find a chemist qualified for the directorship of scientific research of the institute.

THE division of chemistry and chemical technology of the National Research Council, Washington, D. C., has named Dr. James R. Withrow, professor of industrial chemistry at the Ohio State University, chairman of the National Research Council committee on the "Use of sodium compounds as a substitute for potassium compounds, both in scientific and industrial work." Professor Withrow declined the position as chairman of this committee four years ago because of the pressure of university work.

DR. MAXIMILIAN TOCH has been invited to deliver a course of lectures as honorary professor of industrial chemistry at the University of Peking and has tentatively accepted for the latter part of 1923 or the beginning of 1924.

P. VAN DE KAMP, chief assistant at the Observatory at Groningen, Holland, has arrived at the University of Virginia, where he will start a year's research at the Leander McCormick Observatory.

DR. MICHAEL SIEDLECKI, formerly the rector of Vilon University and now a professor of zoology at Cracow, has been invited to lecture at Vassar College during the absence of Professor Cora Beckwith, who has been granted a year's leave of absence.

ST. LOUIS UNIVERSITY announces a series of lectures on "The physiology of the lymphatics" to be given by Dr. Leon Asher, professor of physiology at the University of Berne. These lectures, five in number, will be delivered from March 5 to 9.

DR. E. V. COWDRY, of the Rockefeller Institute for Medical Research, will deliver the eighth Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, March 10, 1923. His subject will be "The significance of the internal reticular apparatus of Golgi in cellular physiology."

PROFESSOR DANIEL STARCH, of Harvard University, gave on January 20 an address at the United States Naval Academy at Annapolis on "The use and limitations of psychological tests."

DR. COLIN G. FINK, head of the division of electrochemistry of Columbia University, gave an address on the "Corrosion of the nonferrous alloys," at the meeting of the New Jersey Chemical Society on the evening of February 12.

DR. PAUL D. MERICA, director of research of the International Nickel Company, addressed a joint meeting of the Minnesota Section, American Chemical Society and the Northwest Chapter of the American Society for Steel Treating on February 19 at the Manufacturers' Club of Minneapolis. His subject was "Nickel, its metallurgical and industrial applications."

On February 16 and 17, Dr. C. E. Seashore, of the University of Iowa and the National Research Council, conferred with the faculty of the University of Kentucky on the problems connected with the encouragement of scholarship among college students. Dr. Seashore also lectured at an open session of the Kentucky Chapter of Sigma Xi on his work in the study of musical talent.

Dr. E. D. Ball, director of scientific work of the United States Department of Agriculture, gave a lecture on "The insect transmission of plant diseases" before the Journal Club of the department of medical zoology of the School of Hygiene and Public Health, Johns Hopkins University, on February 23.

Dr. George T. Moore, director of the Missouri Botanical Garden, delivered the following addresses at Cincinnati on February 12 and 13: Before the Blue Hydra Society of the University of Cincinnati, "Botany and business;" before the Cincinnati Chamber of Commerce, "The relation of the botanical garden to business and industrial life," and before the Cincinnati Chapter of the Wild Flower Preservation Society, "The relation of a botanical garden to civic life, as illustrated by the Missouri Botanical Garden."

Professor Albert Stowell Flint, astronomer emeritus of the Washburn Observatory, University of Wisconsin, died on February 22, aged sixty-nine years.

Dr. Walter S. Haines, for forty-six years professor of chemistry in Rush Medical College, died on January 27, aged seventy-two years.

Dr. James Ritchie, Irvine professor of bacteriology at the University of Edinburgh, has died at Edinburgh, aged fifty-eight years.

Nature reports that "the centenary of the death of Edward Jenner on January 26, 1823, was celebrated by the Academy of Medicine in Paris on January 23. A large meeting was held at the academy in the Rue Bonaparte, when the president, M. Chauffard, gave a short address, followed by a speech by M. Lucien Camus, and by communications on the subject of vaccination from MM. Pierre Teissier, Jeanselme, d'Espine and Sir St. Clair Thomson. The busts of Jenner and Pasteur were placed on the right and the left of the platform. After the ceremony a number of mementoes of Jenner in the form of letters by him, and of old cartoons commemorating or deriding vaccination, were shown in one of the halls of the academy. Sir Ronald Ross, a foreign associate of the academy, who represented the British Ministry of Health, handed in also a letter from the president of the Royal Society. Sir Almroth Wright, another foreign associate of the academy, was also present. After the ceremony the president and council of the academy, in honor of the commemoration, gave a dinner."

The herbarium and library of the late Professor Elias J. Durand, who at the time of his death was chairman of the botany department of the University of Minnesota, have recently been purchased by Cornell University to be installed in the department of plant pathology of the New York State College of Agriculture. The herbarium, which contains over 12,000 specimens, consists almost exclusively of discomycetes, the group on which Dr. Durand was a recognized authority.

Through the generosity of the Botanical Society of Pennsylvania purchases for the botanical department of the University of Pennsylvania have been made from Europe of valuable collections of Cryptogams, especially Bryophytes. These increase manyfold the usefulness of this part of the herbarium, previously insignificant. Additions of this nature approximate 4,000 specimens, with more to come. Further collections include donations from the universities of Copenhagen and Upsala; flowering plants from Scandinavia by Dr. J. W. Harshberger, from Mt. Rainier and the Selkirk Mountains by Dr. R. E. Cleland, from the Northwest Territories by Mr. R. Holroyd, and Algæ and Bryophytes from the Selkirk Mountains and the Bay of Fundy region by Dr. W. R. Taylor.

An International Geographical and Ethnological Congress will be held in Cairo, Egypt, in 1925.

An International Air Congress will be held in London from June 25 to 30 at the invitation of the British government under the presidency of the Duke of York. The Air Ministry has arranged a pageant on June 30.

UNIVERSITY AND EDUCATIONAL NOTES

ACCORDING to a new agreement between the board of permanent officers of the Yale School of Medicine and the corresponding boards of Yale College and the Sheffield Scientific School, admission to the combined course in either undergraduate school will be on a competitive instead of an automatic basis as heretofore. Those seniors will be eligible as candidates for the course whose scholarship standing during the junior year has been seventy-five or above, and who have satisfied the science and language requirements of the medical school. Their applications, which are due before July 1, following the completion of junior year, will, however, be considered in conjunction with all other applications, and the medical class chosen from the entire number of candidates. The Yale undergraduates who are admitted will take the entire first-year medical work and receive credit for the B.A. or B.S. degree. The degree of M.D. is awarded after three years' additional study. As only sixty students are admitted each year from several hundred applicants, the decision to select all members of the first year class in the Yale School of Medicine on the same basis will interest premedical students throughout the country.

DR. W. A. WHITE, superintendent of the Government Hospital for Insane at Washington, D. C., announced the establishment of a school at St. Elizabeth's for the instruction of physicians in the treatment of mental and nervous diseases.

PROFESSOR D. H. DAVIS, of the department of geology of the University of Michigan, has accepted a professorship in the University of Minnesota.

DR. EDWARD A. DOISY has been appointed professor of biochemistry at St. Louis University, the appointment to take effect on August 1, 1923. Dr. Doisy is at present associate professor of biochemistry at the Washington University School of Medicine.

DR. J. C. M. BRENTANO has been appointed lecturer in physics at Manchester University.

DISCUSSION AND CORRESPONDENCE

THE FEEDING POWER OF PLANTS

IN a recent paper in SCIENCE[1] under the caption quoted above, Mr. Truog elaborates and supplements the discussion of his theory on the "feeding power of plants" as detailed in earlier publications.[2] His most recent discussion, as well as his earlier ones, are open to such serious question in many important respects that we deem it essential to comment on the principal objections to his theory and his assumptions. Several minor points in the paper first cited above which are open to serious question are not discussed in this review because of the limited space available (in this paper) and because the importance of the points which we do discuss should not in any wise be dimmed by matters of lesser magnitude.

Mr. Truog makes the fundamental assumption that each and every plant species, or group of plants, is characterized by what we may term a specific avidity for the ions in solution in the root medium, and that such specific avidity is contingent upon the reaction of the cell sap and the behest of the law of mass action. This assumption is, in turn, based on the alleged or actual percentages of the various ions found in different kinds of plants. This implies, of course, the fundamental power of the individual root cell to absorb ions in a characteristic manner. In all this discussion, Mr. Truog evidently underestimates the fact that the differences between plants which are in question may be caused, not by the difference in the specific absorbing powers of individual cells, say of legumes and grasses for example, nor yet by the specific reaction of the cell sap, but by the difference in extent of root system, and the difference in the amount and intensity of CO_2 production by roots. The enormous differences which obtain among different kinds of plants as regards the extent of root are too well known to the student of plants to need discussion, and they can scarcely be considered as of anything but profound importance in the mechanisms of absorption of ions by plants. But, dependent in part upon the extent of the root system, is the degree of CO_2 production, and the latter must play a dominant rôle in making available to the root cells the ions contained in the undissolved compounds of the soil particles. That this is not mere speculation is evident from the striking data adduced by Turpin[3] on CO_2 production by the roots of different plants and the importance thereof in the total amount of CO_2 produced in soils. It is even more strikingly supported by recent investigations of J. D. Newton in this laboratory, which have not yet been published, but which show a marked difference between peas and barley as regards the intensity of CO_2 production per unit weight of roots or tops under controlled conditions in sand cultures. Newton's results indicate further that legumes, as such, are not characterized by a greater Ca content than non-legumes, as such. For example, he found no significant difference between the Ca content of barley, peas and vetch, in solution cultures in which the plants were grown separately or together in the same solution. This was true in solutions of low and of high Ca content. Between beans and barley, the difference appears to have been greater in favor of the beans. On the other hand, in soil cultures with barley and peas grown together, the peas take up much more Ca than the barley. This supports the contention which we have made above that the intensity of CO_2 production, as well as the extent of the root system, may determine the amounts of ions absorbed independently of the specific power of plant species, genera or families in that regard. In this connection, it must be further emphasized that the nature of the environment of the plant, both as regards root and top, may play as important a rôle as any factor in inducing a certain rate and degree of absorption of ions. For example, Waynick[4] showed in experiments in this laboratory that the wheat plant varied *enormously* in its power of absorbing the common ions of culture solutions, depending on the constitution of the solution and the presence or absence of effective quantities of unessential ions. Our studies and observations on individual variabilities in plants in regard to their chemical composition, as in other respects, constrain us, moreover, to say that no justifiable conclusions on specific absorbing powers of different kinds of plants may be drawn on the data available to date. This observation is particularly cogent as regards the attempt to classify the plants supposedly requiring much calcium in accordance with their power to "feed" on calcium and phosphorus. The data employed for this purpose were derived chiefly from Wolff's "Aschenanalysen" and those represent data gathered from many men in many places. Since variability is so marked in plants of a pure strain grown under carefully controlled conditions, what can we expect in the case of Wolff's data but a degree of variability which invalidates the drawing of fundamental conclusions from them? The importance of the variability of the soil, as well as of the plant, as investigations of this laboratory have amply demonstrated, can not be overemphasized in connection with such conclusions as Mr. Truog attempts to draw from ash analyses and similar data.

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[1] SCIENCE, N. S., 56, 1922, pp. 294-298.

[2] SCIENCE, N. S., 41, 1915, pp. 616-618. *Res. Bull.* 41, 1918, Wis. Agr. Exp. Sta. *Soil Science*, 5, 1918, pp. 169-195, and others there cited.

Attributing to an essential element one or more kinds of functions in living cells is a procedure followed without more than the most slender evidence in its support. Highly speculative as this procedure may be, however, it becomes particularly questionable when the functions of elements like Ca and K are supposed to rest upon diametrically opposed bases.

There are other points in the paper under review which require even more critical examination than the one in the foregoing paragraph. We can not conceive of the application of the law of mass action to anything but definite chemical reactions between definite reacting substances and hence there is little likelihood of gleaning anything from an application of the law such as Mr. Truog makes. The reactions in question do not lend themselves to such simple treatment. We deal there unquestionably with complicated dynamic phenomena, which, in turn, may involve certain mass action phenomena, but clearly they are not such as to permit of the simple interpretation given, as even casual consideration of their nature will reveal. It is assumed, for example, that K is precipitated in the living cells through its interactions with the chemical constituents in those cells so as to permit the constant flow of K in solution into the cell from the medium. But any one who has studied the composition of cell sap from a variety of plants can not help but be impressed by the enormous quantities of soluble (not precipitated) K salts which the sap contains and, in all likelihood, in the form of *simple dissociated chemical compounds.* The data obtained on kelp and on other algæ, and those obtained by Kostychew and Eliasberg[5] on other plants, as well as unpublished data recently obtained by Hoagland on cereals, and by Hoagland and Davis on Nitella (a plant used by Osterhout in permeability studies), support the significance and cogency of this statement. Since space forbids our considering several examples, let us study the results on Nitella. This simple alga absorbs K readily from exceedingly dilute solutions thereof and from solutions having a high p_H value to a region within the cell of lower p_H value. This, in itself, proves Mr. Truog's assumption to be fallacious. Hoagland and Davis have found further, in agreement with Osterhout and Crozier that that alga lives in a medium whose p_H varies from 7.2 at night to 9.4 during the day, yet the hydrogen ion concentration of the vacuolar sap of that plant is represented by an approximately constant value of p_H 5.2. Further, Nitella lives in a solution whose Cl content varies from 20 to 30 p.p.m., yet the vacuolar sap of the alga has a Cl concentration of approximately 3,500 p.p.m. Moreover, in suitable media, all the Cl may be taken up by the alga and yet none will pass out of the cell unless the latter is injured, or the normal permeability is changed. Does this in any way support the attempt to apply the law of mass action to absorption of ions by plants after Truog's concept? The general principles gleaned from the work with Nitella should be applicable to plants generally.

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[3] *Research Memoirs Cornell Agr. Expt. Sta.*, Mem. 32, April, 1920.

[4] *Univ. Calif. Publ. Agr. Sciences*, Vol. 3, No. 9, p. 243, July, 1918.

It is, of course, regrettable that this review must be curtailed and that, therefore, a fuller discussion can not be accorded the points which are considered above, and some discussion to important ones which have not been mentioned. Enough has been said, however, to indicate the insecurity of Mr. Truog's theory and of the assumptions upon which it is based. The indications from recent research are that the reaction of plant sap in nearly all plants that have been investigated varies only in a very narrow range (Haas' work on natural indicators being exceptional), and that the conclusion that the ability of plants to absorb K from their media depends on the reaction of the cell sap and that sap of a high p_H permits plants to absorb K more efficiently from dilute solutions thereof than that of a low p_H are probably erroneous.

We may mention, further, in passing, that experimental evidence has been adduced in this laboratory to show that plants do not require Ca in the form of carbonates or bicarbonates since they can grow in solutions so acid that such compounds can not exist to the extent considered necessary.

Finally, we may say in closing that the term "feeding power of plants" is not only insecure, because of its vague support in fact, as partly indicated above, but also because absorption of ions is in no correct sense a feeding by plants and the sooner we give up referring to the mineral elements in soils as plant foods and of speaking of culture solutions as nutrient solutions, the better it will augur for the attainment of that clarity of expression, as well as thought, which are requisite to constant progress in plant physiology, as in other sciences.

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THE PERSONAL EQUATION OF THE ASTRONOMERS

The data reported by Tucker in his communication on "Reaction time and fatigue"[1] does, as he supposes, interest psychologists, but mainly because his results fall within the range of details which have been pretty thoroughly worked out by psychologists. Burrow's monograph[2] contains the best historical account of the investigations up to 1909, and very little has been done on the problem since the publication of my own articles in 1910.[3]

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[5] Hoppe-Seyler's Ztschr. physiol. chem., Vol. III, pp. 228-235 (1920).

[1] Tucker: Science, LVII, No. 1468, February 16, 1923, pp. 204-5.

Although the causal factors have not yet been precisely determined, certain points are clearly settled. First, the "personal equation" is not a matter of reaction-time at all, but a matter of the synchronization of reactions and anticipated stimuli. Simple reactions to visual stimuli are seldom shorter than 100σ (0.1 sec.), whereas the errors in synchronization are usually much smaller and frequently negative. The errors fall within the limits of the imperceptible time interval for the conditions of observation. Second, the usual error, without *practice*, is *negative*, and *practice tends to change* it towards the positive. Third, the same phenomena appear under conditions in which no overt reaction is required, but in which, as in the astronomer's eye-and-ear method and Wundt's complication experiment, the subject is required merely to note the apparent position of a moving object with reference to a series of auditory stimulations. And we are now safe in saying that this is because the latter cases are of the same type as the former, that is, that a discriminative perception is really a reaction: and this in a literal, not a figurative sense.

KNIGHT DUNLAP

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QUOTATIONS

COPERNICUS

THE whole world should observe along with the Poles the birthday of Copernicus, and should continue to celebrate the 19th of February in his memory so long as the earth swings in its orbit; for what this boy, born 450 years ago, and christened Nichola Koppernigk, son of a native of Cracow, conceived as the order of the universe is "the capital event of modern thought." By it mankind's outlook on the universe has been fundamentally changed. The young Koppernigk was a student in the University of Cracow the year in which Columbus discovered America, giving himself to mathematical science and painting. He afterward studied law and attended mathematical lectures in Bologna and still later studied music in Padua and took his degree in canon law in Ferrara. He then devoted his medical skill to the service of the poor, his economic knowledge to the reform of the currency in the Prussian provinces of Poland, and his astronomical genius to the development of a new cosmic theory which has come to bear his name.

It was while he was in the midst of such studies and ministries that the name "America" was first given by others to the fringe of this continent and graven on a map published at St. Dié, at the foot of the Vosges Mountains, in southeastern France. Our continent was thus christened under the Ptolemaic geocentric system. But our national life made its beginnings under the Copernican system and had from the first a "shuddering sense" of physical immensity. It is inconceivable that this new physical conception has not mightily affected man's social and religious conceptions, and especially those of Americans. With the enlargement of the universe under it, and the accompanying diminution of the relative size of the earth—made still smaller by man's improved means of communication—we no longer picture our planet as a flat area divided into exclusive, provincial or national strips spanned by a Ptolemaic sky. We find ourselves "in the same boat" on a sea of practically infinite space.

In observing the birthday of Copernicus the Polish astronomers have fitly gathered in their first congress and proudly remembered what their science has given to mankind; and the Polish people have with good reason held their celebrations all over Poland in honor of the son of the city of Thorn (now again in Polish territory) and the academic son of the

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[2] Burrow: "The determination of the position of a momentary impression in the temporal course of a moving visual impression. *Psychol. Monographs*, XI, No. 4.

[3] Dunlap: "The complication experiment and related phenomena," *Psychol. Review*, XVII, pp. 157-191; "Reactions to rhythmic stimuli with attempts to synchronize," *Psychol. Review*, XVII, pp. 399-416.

University of Cracow (once more a Polish university). But it would be profitable for the whole world—scientists, statesmen, warriors, philosophers, teachers, pupils and the people in general—to pause and consider what was the real significance of the gift of Copernicus. The corollary of his theory is a world-wide solidarity of human interest. There is no escape from it. If an international holiday were to be added to the many holidays in the various calendars of the world, it should be one on which the birthday of Copernicus is solemnly observed—for he discovered the universe.—*New York Times.*

SCIENTIFIC BOOKS

The British Association for the Advancement of Science: a Retrospect, 1831-1921. By O. J. R. Howarth, O.B.E., M.A., Secretary. 14 x 22 cm., vii + 318 pages, numerous illustrations. Published by the Association, Burlington House, Piccadilly, London, W.1, 1922.

American men of science should find much to command their interest in the attractive volume here cited. The book, which is a very readable summary of the development and achievements of the British Association, is replete with information and suggestion for those who hold membership in our scientific societies and in the American Association for the Advancement of Science—especially for those whose hope for our future rests partly in efforts toward the strengthening of American scientific organization.

In these days when the human value of historical appreciation is so strongly and so rightly emphasized on every hand, when the development of the sciences seems almost on the point of becoming subject matter for a new branch of historical science, it is particularly fortunate that Mr. Howarth has been able to present us with this account, which is in some respects a résumé of the history of British science since 1831. The association was founded in that year. The war that finally ended with Waterloo had left the British people with new insight into possibilities for national improvement. Somewhat parallel to what is happening to-day, many minds became constructively critical and there was clamor for many kinds of reform. Among the reformers were leading men of science, who complained of the "decline of science in England" and advocated an association of scientific men as a means toward the attainment of the improvement that was sought.

The British Association was organized at York, on September 26, 1831. The Reverend William Vernon Harcourt, chairman of the organizing committee, proposed the foundation of an association "having for its objects, to give a stronger and more systematic direction to scientific inquiry, to obtain a greater degree of national attention to the objects of science, and a removal of those disadvantages which impede its progress, and to promote the intercourse of the cultivators of science with one another, and with foreign philosophers." So the association came into existence. It was largely modeled after the Deutscher Naturforscher Versammlung, which had held its first meeting at Leipzig in 1882. That organization is now the Gesellschaft Deutscher Naturforscher und Ärzte. We may note further that our American Association was principally modeled after the British, when the latter was seventeen years old.

In a chapter on "The Association and the Progress of Science" is, among others, an excellent account of the two famous controversies between science and religion through which the British Association passed, the first following the general appreciation of the meaning of Lyell's "Principles of Geology," the second following the appearance of Darwin's "Origin of Species." To American scientists these pages are now specially interesting, for history does seem to repeat itself in our midst.

Throughout its history the British Association has ever held strongly to its aim of bringing science to the non-scientific, to society at large, especially to the public of the cities in which the annual meetings are held. General addresses have frequently been given that "demonstrate to all men that science is thinking with and for them, about matters which must interest and most deeply concern them."

The association has met every year since its foundation, with the exception of the two years 1917 and 1918. It has met at thirty-four cities in the British Isles and has held meetings overseas on five occasions—in Canada three times and in Australia and South Africa each once. The York meeting for 1881 was a jubilee, the fiftieth anniversary of the original York meeting. An appendix to the volume presents dates and places of all the meetings, together with biographical notes on the presidents.

Besides holding the annual meetings, the British Association has been active in the initiation of many pieces of research and in the support, through grants, of very many more. A list of grants made in support of research, for the period from 1834 to 1921, is given in an appendix. The association has successfully called the attention of the government to various scientific needs from time to time. It has received some government help, but "to voluntary service in the interests of science the whole record of the British Association stands as one great memorial. Every word spoken at its meetings, every page of its annual reports, represent voluntary effort on the part of individual 'cultivators of science.'"

BURTON E. LIVINGSTON

SAFRANIN AND METHYL GREEN

IN a report last summer made by the Committee on the Standardization of Stains it was stated that good success had been obtained in securing satisfactory samples of almost all the important biological stains with the exception of safranin and methyl green. It is very encouraging now to be able to report satisfactory sources of both of these stains.

Safranin has proved a difficult stain to secure in exactly the right quality, because one is desired which will contrast with both gentian violet and with orange G when used in the Flemming triple stain. The products on the market two years ago when the first samples were collected were generally the textile safranins without much modification and proved to be of too blue a shade to contrast with gentian violet. A sample of Grübler's safranin was compared with them at that time which seemed to give good results, and one manufacturer agreed to duplicate this for the committee. This particular Grübler sample proved, however, to be a mixture of safranin and auramin; and when the American manufacturer made a similar mixture, the resulting shade was found by some of the investigators to be too yellow to contrast with orange G. In one of the laboratories where it was tested, however, it was found to be entirely satisfactory for the particular purpose for which it was used, and it is felt that this mixture may well have its value but should not be sold as a safranin. The matter was in this state when it was finally referred to the National Aniline Company. They have now prepared a safranin which is very pure and considerably more concentrated than any which has before been put on the market. It has been reported upon in the highest terms from every laboratory except the one where best results were obtained with the mixture of safranin and auramin. It seems to give satisfactory results in the Benda stain with light green, also in contrast with both orange G and gentian violet and appears to be identical with the best of the pre-war Grübler safranin O, except that it is more concentrated.

Methyl green is used quite largely in the Pappenheim stain together with pyronin; but it is also used by botanists in staining plant tissue and by zoologists as a chromatin stain, and for staining living protozoa. The first samples of this stain obtained in this country were apparently either methylene green or methyl green with violet impurities, probably methyl violet. Of the samples obtained in the original investigations of the committee none proved very satisfactory; but last summer a sample was obtained from the Providence Chemical Laboratories of Providence, R. I. which has proved as satisfactory as the samples of Grübler's methyl green with which it has been compared. More recently a series of three samples, each one purer than the preceding, have been sent to us from the National Aniline Company. The first sample proved unsatisfactory; the next one submitted proved of good quality, while the most recent sample submitted seems to be one of the purest samples obtainable. There is still some question, however, which of these methyl greens is actually the most satisfactory when judged from the standpoint of performance. Although one laboratory has reported in highest terms of the purest of these samples, two other laboratories found best results with one of the less pure methyl greens. It is not impossible that some of the impurities present in Grübler's methyl green may have been of special value in staining. If this is the case, it is plainly the problem now for biologists in cooperation with the manufacturers to find out what these particular impurities were. Meanwhile it seems safe to recommend any one to buy a methyl green from either of these two companies, in as much as their methyl greens are evidently as good as any obtainable at the present time.

The findings obtained in this investigation have been very interesting in showing the amount of variation in different lots of Grübler stains. Before obtaining the satisfactory American sample of safranin O, mentioned above, data were secured concerning the properties of two different Grübler samples. One proved to be actually safranin O, but with considerable inert material (dextrin). The other proved, as stated above, to be a mixture of safranin and auramin, and contained fully 90 per cent. dextrin. Although considerable variation has been found in the samples now on the market in this country, no two samples of safranin have been found differing from each other to such an extent as these two samples, one imported before the war, the other during the war.

Attention is called to this fact to show that standardization can not be obtained by going back to imported stains. There is, moreover, very good reason to believe that the imported stains now on the market are still different. Investigation of this point is in progress at present. Meanwhile we have learned of one well-known German laboratory which has just ordered stains from America, with the comment that the European products are now very unsatisfactory.

H. J. CONN

Chairman, Commission on the Standardization of Biological Stains

GENEVA, N. Y.,
FEBRUARY 20, 1923

SPECIAL ARTICLES

FURFURAL AS A BIOLOGICAL REAGENT

IN spite of its wide range of solvent power, preserving qualities and rapid penetration of tissues, furfural has remained until recently a chemical curiosity, its properties and even its appearance practically unknown even to many who have frequently employed it. Investigations concerning its uses as a biological reagent have been wholly confined to its physiological effects. This is perhaps due to the fact that until recently it has not been manufactured in commercial quantities, being little used in the industries. Now, however, the "Miner Laboratories" of Chicago have developed a process of manufacturing furfural from oat hulls which are obtained in large quantities as a by-product in several industries. At the same time several commercial uses have been developed in the manufacture of resins, varnishes, rubber, dyes, perfumes, anesthetics, antiseptics and germicides. Thus larger demand and increased efficiency of manufacturing process have made possible the reduction in price to a point where it bids fair to become the cheapest aldehydic body commercially available.

Furfural is an aldehyde of deep amber color and a pungent odor, having the formula C_4H_3OCHO, which, in general, resembles the reactions of benzaldehyde on the one hand and formaldehyde on the other. It differs from either of them in being a liquid of very high boiling point and wide range of solvent power. As a biological reagent its chief interest lies in the fact that its properties closely resemble those of formaldehyde, suggesting its use as a preservative, and secondly its wide range of solvent power including most of the coal tar dyes, hæmatoxylin, alcohol, xylol, toluol, benzole, balsam and parlodion, suggesting its possibilities as a vehicle for stains as well as a general reagent in micro-technique; and thirdly, its reaction with acids forming resins, suggesting its use as an injection fluid.

In connection with current laboratory procedure we have had occasion to test out furfural in these three fields and the results are herewith reported.

The qualities of furfural as a preservative were investigated for a period of four months on several animals used in the laboratory for dissection purposes, such as cats, frogs, fish, mussels and some plant forms. Although H. McQuigan ('22) has shown the germicidal and toxic properties of furfural to be less than that of formaldehyde it has nevertheless been adequate to preserve these specimens in good condition. Two strengths of solution were used, ninety-five per cent., or commercial furfural, and a seven and one half per cent. aqueous solution, both of which have proved successful. Furfural is soluble in water only to the extent of eight per cent. at room temperature. We therefore used a solution slightly below the point of saturation. This strength of solution seems to be preferable as it does not discolor one's hands or the tissues to so great an extent and the odor is not as objectionable as with the commercial furfural. Such stock solutions for preserving purposes are most conveniently prepared by adding five pounds of furfural to a carboy of water and decanting off the saturated solution as it is needed, refilling with water until the furfural has been used up.

In each case the body cavity was opened so that the viscera were well exposed to the solution. After one to three months the specimens examined showed organs in a good state of preservation and did not show as great shrinkage or hardening as in those preserved in formaldehyde. In the case of frogs and mussels, the viscera were preserved in nearly as plastic a state as when living.

In general it has a tendency to discolor the tissues a yellowish brown, and the musculature of those specimens into which the ninety-five per cent. solution had been injected turned a deep brown color. This effect which would render furfural objectionable as a preservative for museum specimens is not very objectionable for dissection purposes. The mould Penicilium which here grows so profusely on formaldehyde solutions did not develop at all on the seven and one half per cent. furfural, although the solutions were repeatedly inoculated. Tested on pieces of muscle it also showed more rapid penetrating qualities than in the former. Although it has a somewhat pungent odor, its low vapor tension renders it less offensive than formaldehyde and in the seven and one half per cent. solutions the odor is scarcely noticeable. The irritating effect on the nose and eyes, so objectionable in the case of formaldehyde solutions, is here eliminated entirely. The same may be said with regard to its effect on the skin, where, although it does cause a yellowish discoloration it does not have the tendency to harden and shrivel it. The discoloration can readily be removed by washing the hands in warm water to which has been added a little ammonia.

If an acid such as hydrochloric or sulphuric is added to furfural it forms a resin. The rapidity with which the reaction takes place depends to some extent upon the amount of acid used. One cubic centimeter of HCl to one thousand cubic centimeters of commercial furfural completed the reaction in about thirty-six hours. The resultant product was a semi-solid spongelike, jet-black resin. This reaction was made use of for injection purposes and rendered the arteries and veins very conspicuous. Cats were used for this test, which were injected through the femoral artery with a ninety-five per cent. solution of furfural to which had been added, just previous to injection, one cubic centimeter of HCl per one thousand cubic centimeters of the former. Such an injection fluid is much more conveniently prepared and injected than the usual injection mass and is also cheaper.

In the field of micro-technique furfural promises to be a very useful reagent because of its wide range of solubility. Its penetrating qualities, together with the fact that it dissolves the majority of the coal tar dyes, makes it possible to use it as a vehicle for these stains. Secondly, it is miscible with alcohol in all proportions and can be used as a substitute for the higher percents in the dehydration process. Thirdly, it is soluble in all the aromatic hydrocarbons such as benzol, toluol and xylol. The same is true with regard to the oils such as bergamot, cedar and clove, and lastly even gum damar or Canada balsam. Thus it shows a wider range of adaptability to the different formulas than the alcohols, with a corresponding shortening and simplifying of several of the processes. It is the most rapid solvent of Celloidin or Parlodin that I know of and makes possible the elimination of the slower and more expensive ether alcohol method. At present tests are in progress in this laboratory on these properties of furfural with a view to determining its adaptability to this phase of the work.

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THE NEED OF MONOGRAPHIC ACTIVITY IN AMERICAN BOTANICAL TAXONOMY[1]

It recently fell to my lot to oversee the reclassification of a large botanical library during its reshelving at the Gray Herbarium. Many questions arose during the process, most of them relating to clearness and expediency from the standpoints of library methods and experience. With these I will not trouble you. But incidentally I was impressed by certain quantitative aspects of botanical literature, particularly of taxonomic publication. These proved interesting to me and I hope I can make them so to you.

Nearly all publications on systematic botany fall pretty readily into one or the other of two chief categories: they are either floras, dealing with the vegetation of some particular region, or they are monographs treating a special group of plants. Our fundamental division was, therefore, into floras, arranged geographically, and monographs, classified systematically.

In this grouping the first thing that struck me was the overwhelming predominance, both in bulk and numbers, of the floristic works over the monographic. The second was that of the monographs, that is to say of those works treating not a region but a particular group of plants; the output in America has at all times been exceedingly small compared with that in Europe. Finally it was evident that most of the monographic work thus far accomplished in America has been restricted to purely American groups, exceedingly little of it taking on a cosmopolitan character.

The historic reasons for this state of affairs are tolerably obvious and there is no need to go into them at any length. American botany is relatively recent and its workers, at no time very numerous, have been confronted by the overwhelming task of reducing to systematic record the immensely diversified flora of a continent. Until lately the United States has not been a colony-holding power. Its scientific collections have not had that influx of material from remote quarters of the globe which has for many decades, indeed for two or three centuries, been pouring into the great herbaria and stimulating research in several of the Old World nations long holding remote colonial possessions.

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[1] A communication read before the Systematic Section of the Botanical Society of America, December 29, 1922.

Whatever may have been the causes the fact is one which we must face. Certainly more than ninety per cent., probably ninety-five or even ninety-eight per cent. of the cosmopolitan treatments of plant groups have been elaborated and published in Europe. In this form of botanical activity America has shown striking lack of ability or want of interest. She has never even tried to do her part. It is worth while to examine this particular form of aloofness. The pertinent questions are these: In how far is monographic activity really important? If it is of fundamental significance in our science, why are we so backward in regard to it? Is our nation active in proportion to its ability? Is it subject to some handicap precluding efficiency in this field? Is it unconsciously shirking an obligation? Is it missing an opportunity? Finally, what is the relation of such close and detailed study of plant groups to our national power, to our preparedness both in war and peace?

To answer such questions it is of the first importance to grasp the relations existing between floristic and monographic research. It must be understood that they are coordinate modes of investigation, of like dignity, difficulty, scope and importance. Each, however, has its peculiar advantages, each its specialized methods, each its allure, its psychological bias, each its practical importance in the ultimate scientific record of the world's vegetation. From a theoretical standpoint their material is of like extent as in qualitative and quantitative analysis. The task of the systematist will not be completed until each region has its flora and each natural group its monograph.

The materials for floristic work are everywhere ready to hand. Each region has its vegetation. Its plants attract by their diversity. The study of a local flora has great fascination. It appeals alike to amateur and professional. It is replete with opportunities for field work, personal collecting, exploration. It is in large measure an out-of-door job. Usually it is also a companionable enterprise involving cooperation, since few floras can be prepared by the single-handed exertion of any one investigator.

The monographer, on the other hand, must have access to large collections and libraries. Even then he must patiently assemble much of his material by correspondence. The plants of his group are likely to be scattered in remote quarters of the globe. He is rarely able to see them—at least most of them—in nature. He has to work with other people's specimens and make the most of collectors' notes. His task is chiefly an indoor one. It is apt to be a lonely one.

The published flora is a matter of popular interest. It has a sale. There are even calls for successive editions. It is true its author is rarely enriched by the proceeds, but he has the gratification of knowing his work useful. He sees that it meets with a measure of appreciation.

The monographer finds his wares much less in demand. He almost always has difficulty in securing a publisher. The sale is slight and very slow. In other features of his task, however, the monographer has advantages over the floristic writer. Floras usually have many hundreds, often thousands of species. If their treatment is to be completed in a lifetime there must be haste. If the result is to be brought within the limits of publication there must be compression. Elimination becomes necessary. Exceptions must be suppressed. Doubtful cases may not be discussed. Synonymy must be trimmed to its most important elements. Bibliography has to be cut to a minimum. Even descriptions must be brought down to telegraphic brevity. The final product becomes dogmatic.

The floristic writer, thus overwhelmed by the number of elements to be treated, is forced to relegate extra-limital species to temporary oblivion and neglect, except in so far as their hurried examination is necessary to establish the identity of plants within his range. Furthermore, the elements included commonly form only small and disjointed fragments of the natural groups they represent. This frequently lends them a specious distinctness which they are far from possessing in nature. There is an almost unavoidable temptation to distort categorical values. Thus a variety in nature may in a given region appear to be a species. Still more frequently a subgenus or section tends to assume undue clarity and seems to merit the rank of a full-fledged genus.

It is in the monograph that nearly related plants are brought together no matter what their geographic remoteness may be. It is to the monographer that we must turn for well-judged estimates of the distinctness of groups and of their appropriate rank in classification.

In general the monographer is less closely tied down by the limits of time and space. His group usually contains fewer species. They can receive greater individual attention. Transitions and exceptions can be discussed. Descriptions can be drawn in far greater detail. Complete synonymy, copious bibliography, and the citation of exsiccatæ become features of importance. The monograph is rarely undertaken in the course of professional routine and surely never for personal gain. It is the kind of thing which must be done *con amore* and in a leisurely way—a charming puzzle which must often be laid aside only to be taken up again as opportunity permits. There is nothing that the monographer loathes so much as compilation. He must acquire not merely a bowing acquaintance but a real friendly familiarity with each element in his group. Many of his most important decisions come toward the end of his work, being doubtless brought about by cumulative observations and slowly trained judgment.

Let no one understand me to imply that work of this nature is not done in our country. There have been notable examples of it. Where may the world look at present for special knowledge of groups like the Laboulbeniaceæ, certain portions of the Orchidaceæ, and of genera like Yucca, Phoradendron, Nymphaea, Cuscuta, Lonicera, or certain parts of that exceedingly difficult family, the Cactaceæ? Many other groups also are now being studied in truly monographic spirit. The rusts, the hepatics, the mosses, the ferns, the grasses, Carex, Passiflora, the Scrophulariaceæ, the Lentibulariaceæ, certain portions of the Compositæ, for example. The work of most of the investigators here alluded to has undoubtedly begun from interest in the local North American elements in their respective groups. It is, however, apparently taking a broader turn as time goes on and we may hope for a finished monographic result.

Nevertheless, any such list of monographic undertakings in the United States is impressive not by reason of its length, but quite to the contrary. Its wide gaps are its striking feature. While one can well-nigh count upon his fingers the groups which are now being followed up in our country with any prospect that their treatment will take on a cosmopolitan scope, there are scores and hundreds of groups for which no North American specialist is yet in sight or even remotely in training.

Floristic and monographic work are reciprocal and interdependent. Both are essential to satisfactory progress in our subject. Floristic endeavor is certainly the pioneering enterprise. It is to secure knowledge of the general vegetation not of particular groups that practically all botanical exploration is initiated and collections are brought together. Thus until floristic work has made some headway monographic activity is impossible, but on the other hand floras can attain excellence only in proportion as they gradually assimilate the results of monographic investigation.

It is to the monographer that we must go for detailed elaboration and for highly trained judgment as to categorical values. To the floristic writer we look for things no less important, namely careful elimination, terse presentation, clear keys, and for the works that popularize our subject. Were there no other grounds than these it should be clear that our country ought to be doing its fair share of monographic as well as floristic work. But there is another point that I would emphasize. A good monograph can not be produced without creating *ipso facto* a specialist, a person of trained familiarity with a group, an authority to whom we may turn for precise and prompt information concerning it. Such specialists are national assets.

The practical importance of plant classification is little understood. Very few people realize the great number of plants which have come to have economic and industrial significance. Vegetable products are so important to humanity and their use for foods, fibers, medicines, timbers, dyes, condiments, flavors, oils, waxes, gums, resins, and what not, has become so much a matter of course that it is apt to be taken for granted. I am told that in horticulture alone more than twenty-five thousand kinds of plants have been brought into use and thus acquired commercial value. Hundreds of others have gained significance in pharmacy and the industrial arts. But the most pertinent fact of all is that there are still thousands of plants which have never been investigated as to their possible utility—species either not yet collected at all or so imperfectly known that they could not at present be precisely identified by any systematist in our country.

Do we not clearly need specialists? Can we get them in any other way than by encouraging monographic attention to particular limited groups? We have long been dependent upon our European colleagues for nearly all monographic works of reference. Recent years have greatly altered conditions. The European output of this type of finished work of reference has already been diminished. It is clearly up to us to do our part, indeed for the next two or three decades if possible rather more than our normal share in this highly significant activity.

How is this work to be fostered? Gradually, of course. No abrupt change would be either feasible or desirable. Much may be accomplished if the need is clearly grasped. Let each botanical establishment, each botanical society, club and journal stress the importance of this type of published output and facilitate the initial efforts of all students, whether professional or amateur, who are found to possess appropriate talents or a bent toward work of such concrete and scholarly nature.

There is no way to acquire an art but by practising it. The art here suggested has from theoretical importance and practical utility much to recommend it. It has, furthermore, no small charm in itself. As a hobby for the cultivated layman it is hard to imagine a more fascinating pursuit than the gradual assembling of materials and data for such an enterprise. Unhappily members of our small leisure class —using the term even in its most favorable sense—rarely have the requisite intellectual ambition or the needful concentration. Monographic results are much more likely to come from the spare hours of the physician, the lawyer, the banker, the business man. Such persons in gratifyingly large numbers are taking an interest in systematic botany. Around botanical centers there are scores of them, consulting professional herbaria and libraries and building up their private collections. They are active, energetic, gifted with fine enthusiasm, and often decidedly helpful, but as yet they show little ambition beyond the minor problems of their own local floras or the vegetation of the places visited during summer outings. Certainly it should be possible to stimulate such promising material to monographic activity.

As to the professional botanist, I am so optimistic as to have hope even there. After due allowance for those who in quest of microscopic detail or physiological reaction have drifted far from taxonomic interest, after eliminating the overworked whose professional routine in classroom or laboratory depletes every enthusiasm for botanical activity, after admitting that many hours of the academic year and no small portion of the vacation periods must be devoted to text-book writing, popular lectures, summer school instruction, or other remunerative employment to piece out inadequate salaries, still there must be a residuum.

Nearly all botanists in the course of their training or professional work have been consciously attracted by some group of plants. It is well-nigh impossible to occupy oneself seriously with any phase of plant-life without developing such an interest, without coming to have a sort of pet group. Many have had incipient ambitions to make something of such interests. It is reasonable to hope that with increasing facilities from the growth of neighboring collections and libraries more such beginnings may develop to monographic fruition.

Where such an interest can be initiated or revived it could often be pursued with growing enthusiasm. Appropriate groups of plants are of all sizes and degrees of difficulty. Manifestly it would be preposterous for any but the best equipped and already experienced workers to undertake the willows, sedges, asters or œnotheras, not to mention the aroids or palms, but there are hundreds of genera of moderate size still very imperfectly classified—groups where the patient and conscientious attention even of the amateur would bring results highly interesting to himself and decidedly useful to our science.

Let us do our best to stimulate this intensive examination of particular groups. We *must* do so if we are not to be chiefly dependent upon foreign works of reference. Much as we owe to these foreign treatments—and I am most humble in my respect for many of them—I am convinced that were similar activity to be fostered in America it would have certain merits of its own. There are some prevailing defects in monographs. Many of them lack clarity. Many reach a tedious degree of detail and in their ultimate subdivisions border on the artificial. One reason why I greatly hope that more of my compatriots will engage in monographic work lies just in the fact that there will be limits to their patience, that they will seek the practical, and will in general stop subdivision at the point where distinction becomes inadequate or where further classification would pass the bounds of probable utility.

B. L. Robinson

UNIVERSITY CAREERS IN MEDICINE AND SURGERY[1]

A short time ago when the opportunity arose to talk informally with some of you and your classmates, I presented as a general subject, "The selection of a career in medicine." This is an almost impossible topic for anyone to give you final advice upon, since, in order to justly appreciate a given student's abilities and possibilities would necessitate a far wider acquaintance of the individual student's upbringing, environment, and character than is possible for any of your present instructors. However, it does seem as if the possibilities of choice might well be laid before you from time to time in order that you yourselves should fully understand what fields of endeavor are open to you, and that you yourselves may begin to sift out of the many walks in life that particular career to which you find yourselves attracted and by nature better fitted to fulfill. In view of the present dilemma the graduating class finds itself in, it seemed possible that a further discussion of this topic might not be amiss. And since my own life has given me most experience in but a single direction, I have chosen as a title for this occasion, "University careers in medicine and surgery."

As I pointed out on the former occasion, the student may choose broadly between practice and a university career. In the field of practice, he may be physician, surgeon, take up a surgical specialty, restrict his field to internal medicine, X-ray, metabolism, or do everything in that most honorable rôle, the country practitioner. Likewise, if he chooses a university career, he has an equally wide choice varying from any one of the multitudinous laboratory posts to a career in the clinical branches of medicine and surgery.

You will see that I have made the art and science of teaching the dividing line. That is really the great dividing line. Do you want to, are you able to, and will you spend the time necessary to equip yourself for the task of teaching? It is by no means a simple task. In fact, in addition to the difficulties attendant on obtaining a good training and developing one's inborn characteristics, there are many pitfalls for the teacher. The same dangers confront all teachers. The worst of these is self-satisfaction. Many a teacher has, to put it brutally, heard himself deliver hypotheses so often that finally he actually comes to believe ideas that are not entirely supported by facts; he then becomes narrow, dictatorial, and pompous. Such an attitude is less common among instructors in the preclinical sciences and those untrained in laboratory methods. Such men are not real teachers; they are but go-betweens. The real teachers often talk but little and teach to a great part by precept and example coupled with a spoken idea, a suggestion, and a little encouragement. Their methods are to develop the student, not to propound their own views; to lead rather than to drive.

I make some diversion here, since, unless you are endowed with certain qualities and realize what teaching is, you can easily go astray in your choice. But I have especially emphasized teaching as the dividing line because in the last score of years the words research and laboratory have become coupled in medicine with the words success and training. And the impression has been given that the great dividing line in medicine is whether or no one is a researcher or has had a laboratory training. Indeed, the phrase "he is an untrained man," meaning untrained in laboratory methods, has been used almost as an opprobrium. This has driven many into laboratory efforts who are neither able nor eager to frequent this field. A true researcher is more a born man than a made product. And so, much time, much precious effort has gone astray. And an immense amount of published effort has appeared that is of no value either to the worker or his readers.

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[1] Presidential address, Boylston Medical Society, Harvard Medical School, December 15, 1922.

As a further objection to research as the dividing line, I need only point out to you that research can be carried out whether or no one is a teacher. Moreover, it is carried on, and to a large extent by those in no connection with universities. Much, too, of the best sort, for I need only recall to you Sir James MacKenzie's work on the heart as a single example of such extramural effort.

To some extent, teaching also may be criticized as the great dividing line, since medicine is inherently a profession acquired by apprenticeship, a profession for centuries descending regularly in families, where father was the teacher and son the pupil. To such an extent, indeed, all doctors are teachers, and not only of their assistants and colleagues, but of the community at large in which they live. For this latter burden is a part of their very ethics which makes it incumbent upon all medical men to help alleviate suffering whether by prevention and public education, or by dispensing medicine and care when actual disease is present.

Teaching in the university sense, however, has a larger aspect, and it requires a special training and special qualifications. For it involves not only the handing on of known facts, but an ability to stimulate students with a desire to further enlarge the known facts in regard to their profession, and further, a training that can advise and direct such ideas as the student acquires into workable and productive fields. You must realize the vast differences among your own instructors and must recognize that certain of these have added qualities, either naturally or by virtue of special training, that make them both better able to hand on knowledge to you, and more stimulating as regards the breadth of knowledge you are to acquire.

We have, however, a peculiar anomaly occurring in our own time, that though a great teacher is great for the most part through inborn, natural characteristics, and though such a man must be of the greatest value to any school, the schools themselves in the last score of years have not always made appointments with this in mind. As outlined above, research qualities have often appeared to be the potent factor in the choice of faculty incumbents. That is, teaching *per se* does not seem to be looked upon as a prime factor in making appointments to university medical faculties.

Before discussing requisite characteristics for a university position in medicine or surgery, let us define what such a position may be. In the first place, by a university position I mean one wherein teaching and the hospital claim all the efforts of the individual. Practice becomes a secondary factor. The extension of the so-called full time plan of teaching to the clinical branches is something that in this country is still in its infancy. In Germany it has long been a fact, and the division there is based, as I have depicted it to you here tonight, on a teaching position. The German plan, however, does not demand all the clinical teacher's time, as is demanded of a professor of physiology or pathology, which is the modern "American" concept of full time clinical positions, but embraces the underlying principle that the university work is of first importance. The full time plan recognizes the value of education as well as of practice to the community. It is based on the assumption that a great educator in clinical medicine is equally great as a great practitioner of medicine. And the use of preventive as opposed to palliative medicine has been a great incentive. The actual dealing with the sick is an ancient and honorable profession, but the science of preventive medicine is a profession on a still higher plane. That should be the aim of those holding university positions. The full time scheme in clinical medicine substitutes research to be associated with teaching instead of the practice of medicine alone. There are those who claim that men thus devoting all their time to hospital practice can not properly teach students who are to practice by themselves in small, remote communities. These men, however, fail to be convincing, if only through inconsistency, for they are the very ones who most fully praise Osler's text-book, "The practice of medicine," a work written by a man more than any other an exemplar of this idea.

The fundamental principles are often beclouded. The full time scheme means nothing more than that the incumbents of such positions devote their entire time to teaching and to the hospital. It does not of itself preclude private practice. Indeed, it would appear that there are certain advantages, sufficient indeed to offset obvious disadvantages, should the incumbents of such positions be allowed to have the responsibility and opportunity to see private cases in moderation. The experience and stimulus resulting from this is invaluable, and it is a fatal error to think that a professor of medicine or surgery should only be appointed from those individuals who have already acquired all of the benefits that do accrue from such work.

From the above considerations, it is obvious that the qualities of a teacher and of an investigator are prime requisites for entering upon a university career in medicine or surgery. As has been already stated, a great value has been placed on research, and university posts have, in several instances, been awarded to those whose chief and often only attribute, in so far as eligibility for the position goes, has been that the individual has completed a valuable piece of laboratory work. Such men have naturally not always proved good teachers, and yet even this method of selection has advantages over the older method of choosing the man whose only attribute was his success in the practice of medicine, because in the former case we have a man who at least devotes his entire time to his job. In the latter case, teaching and school work were and often are taken on as incidentals. And yet I must warn you that faculties of reputable schools are still filling important positions with this latter type of individual, so that even should you perfect your training as a teacher, clinician, and laboratory worker, you may still find a man whose chief claim is that he is a successful practitioner as your colleague or chief.

Of course, there is room for all, and the part-time men, as this latter group has been designated, are invaluable in a faculty. Indeed, this type of teacher is not only a valuable asset, but a prime necessity. In the first place, they keep the hospitals and schools in close touch with the community, and they diffuse the knowledge and facts gained by those men in university life best trained to develop such knowledge.

The ideal man for such a position, however, must devote his entire time to his school work. He must, in the first place, have had a broad, general training. Whether he specializes later or not is of only relative importance. He must be acquainted with laboratory methods, not only because he can thereby stimulate his students to, and aid them in solving such problems as come before them, but because of the mental training involved. A training in experimentation involves a training in accuracy. It involves accurate observation, logical deduction, and the bringing forth of conclusions based on fact. It tends to do away with conjecture, ideas based on supposition, hearsay and single isolated observations. And it finally teaches the value of controls. This is a training in thoroughness which no amount of clinical training can equal, partly because in clinical work there is always that "hoodoo" of routine. Certain disconnected things must be done, and then if there is time, the problem which interests the individual can be studied. But how rarely is there time! It is only the very exceptional man who has the physique alone to tackle painstaking investigation on top of the routine of a day's work in a clinic. This is especially true of surgeons whose therapy means hard labor as opposed to the medical man's therapy which in many instances the flourish of a pen leaves to a nurse.

But finally, given a man with a broad clinical training, and one whose published work proves his laboratory training, we still lack something. That something is what makes him a teacher; it is an intangible quality that our language still lacks a proper word to describe. The French call it *l'esprit* and the Germans *geist,* words that now mean one thing and the next another. It is, however, present in all teachers. It is a quality that makes others want to do the same, a certain form of magnetism, of stimulus, of optimism. Teachers as well as leaders often work more influence by precept, example, and their own actions than by the spoken word. It is an indescribable quality, and a perfectly worded discourse in which every step rests on proven and established facts may leave the class busy with pencil and paper, whereas another teacher using imperfect diction and presenting his facts in a less orderly fashion may keep every eye and ear so busy that note-books remain untouched. The latter is the real teacher.

These, then, are the essential qualities for the ideal man in university medicine. One does not expect to see them all in full bloom in any individual; but to those of you who contemplate a university career in medicine or surgery, it is well to depict what may be expected of you.

The varied training necessitated will encompass roughly eight to ten years. These years may be divided in the ratio of three to the laboratory and seven to the clinic, and it is my impression that part of the clinical training should come first and part last. It is customary to advise first an interneship, then a resident's post using up perhaps three years; next comes the laboratory. Here the choice must be very wide. It might well be divided into a further training in one of the basic medical sciences followed by two years of experimental endeavor. These years completed, the man steps into the higher resident or assistants' posts in some clinic. From this time on, his mind having been trained in investigative methods, and a greater opportunity for clinical research both as regard material and time being offered, his publications should become true reflections of his value, tendencies, and promise. He now has greater occasion to teach and can well spend a large part of the next few years perfecting what qualities he has in this field. Such a person should now be ready for a high university post.

This is a long span of time, and we may well recollect that life is short. Moreover, the pecuniary reward is small. Still, such posts as those described, except for that of interneship, pay small stipends from five hundred dollars to fifteen hundred dollars. It is not, indeed, the easy task imagined by some of the great group of practitioners who look upon such people as peculiar individuals. But I can tell you that it has high rewards. In the first place, it is always a joy to do work well, and such a training almost insures this. In the next place, to find out the truth by an investigation is a tremendous stimulus. And lastly, it leads to a position in life that keeps one always in contact with vigorous, fresh, inquisitive minds; a position that both keeps one's own mind young as well as gives one the great happiness of seeing other minds grow under a little stimulus, a word of encouragement, or a proper example.

I have, as many of you must know, given much of my own ideas and experiences in this talk; and yet as I wrote it, I had piled on my desk clippings, books, and quotations covering most of the contributions on this subject during the past twenty years. In reading them, I found always the same undercurrent, a feeling that the teachers of medicine must be better trained. What I have written of the ideal man, of his qualities and abilities, is but a summary of the views of others also. It is a description of a field of endeavor for medical men that has been slow to arrive in this country, but which will certainly be in full swing before your generation has passed on.

I beg of you to remember that what I have said is purely from an idealistic point of view. No criticisms have been made. Do not for a moment carry away the idea that I belittle the practice of medicine as opposed to the field of medicine described. I would only have you remember that a university career should require a definite training, if we are to raise medicine to higher levels. Something of what that training must be, and that that training is necessary and logical, I have tried to show you to-night.

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PETER BENT BRIGHAM HOSPITAL

IONIZATION AND RESONANCE POTENTIALS[1]

THE phenomena connected with luminous discharge in gases at low pressures have received a great deal of attention during the past twenty years. Many theories have been worked out to explain these phenomena, but until very recently no satisfactory explanation of the relation between the energy necessary to produce ionization of gaseous molecules and the voltage required to produce luminosity in a gas had been advanced. The advent of the electron theory and more recently of the Bohr theory of atomic structure have greatly stimulated activities in this field and it seems likely that most of the facts hitherto regarded as simply empirical will be explained satisfactorily in the near future. It seems probable, at the present time, that a comprehensive theory of the luminous discharge will only be obtained by a thorough study of ionization and resonance potentials. Moreover, research in this field will undoubtedly aid in solving many of the complex problems of photochemistry.

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[1] Address presented at the Boston meeting of the American Association for the Advancement of Science, Section C.

Ionization and resonance potentials can be calculated from the corresponding spectrum lines by the simple relation

$$V = \frac{hc}{e\lambda 10^8}$$

c being the speed of light, λ the wave length of the spectrum line, e the charge on the electron and V the voltage. The resonance potential of an atom is the minimum potential through which an electron must be accelerated when started from rest in order, when it collides with the atom, to displace an electron to an orbit further from the nucleus. There are naturally a great number of resonance potentials for each type of atom, depending on the number of possible orbits to which the electron may be removed. Corresponding to each resonance potential there is a line in the spectrum of the element. Light is emitted when the electron returns to an orbit nearer to the nucleus than the one to which it had been displaced. The light may also be emitted with several frequencies. For example, if an electron had been displaced from the 1 orbit to the 3 orbit it might return to the 2 orbit and then fall back to the 1 orbit after another interval of time. Light of two frequencies would then be emitted instead of the single line corresponding to the 3—1 transition.

When one of the outer or valence electrons has been completely removed the corresponding speed of the impinging electron is called the ionization potential. The light emitted when the electron returns from infinity to its normal position is of the highest possible frequency and this line is the head of the principal series of the element in question. Here again, if the atom is ionized the electron may return by stages and the whole spectrum of the element may be emitted. There may be several ionization potentials corresponding to the removal of one, two or more electrons. Some determinations have been made of the energy necessary to remove a second electron from an atom, for example, to change He^+ to He^{++}, but in general we are concerned with the ionization potential corresponding to the elimination of one electron.

There are several methods of measuring ionization and resonance potentials, but few of the methods distinguish clearly between the two. One method consists in gradually increasing the potential between two electrodes and noting the production of radiation by its photoelectric effect on another electrode placed in the tube. While some idea of the frequency of the light emitted may be obtained by measuring the velocity of the photoelectrons produced, this method does not distinguish definitely between the two types of electron impact. If series relationships for the gas being studied are known, it is possible to obtain some idea of the voltage necessary to produce ionization, but the energy necessary to produce ionization when an atom has already suffered a resonance impact is less than the normal ionization potential, so that results obtained by this method must be interpreted with care. This method has been used by Franck[2] and his coworkers in studying the radiation potentials of mercury.

The three electrode, or even four electrode, tube has been used in measuring ionization and resonance potentials. Many modifications have been proposed. Among the most important might be mentioned those of Lenard,[3], Compton[4] and Davis and Goucher.[5] In most of the methods there is an element of uncertainty due to the velocity of thermal emission of the electrons. While tables have been made out giving the velocity distribution of the electrons at different temperatures, the correction due to this factor may be fairly large. One method of applying it is to place a negatively charged grid in front of the filament so that only those electrons with high velocity will pass through. By measuring the apparent ionization potential of a gas whose ionization potential is known, the magnitude of the correction may be determined. Results show wide variation, however, and the magnitude of the correction undoubtedly depends on the physical state of the filament, the nature of the gas being studied and the potential drop along the filament.

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[2] *Z. Physik.*, 2, 18, 1920.

[3] See Hughes, "Report on Photoelectricity," *Bull. Nat. Res. Council*, 2, 83, 1921.

[4] *Phil. Mag.*, 40, 553, 1920.

[5] *Phys. Rev.*, 10, 101, 1917.

Foote, Meggars and Mohler[6] used a three electrode in which the grid was a spiral wound as closely as possible around the filament. The grid and plate were directly connected together. The electrons were accelerated by the potential on the grid and plate, passed through the grid into the force free space beyond. The radiation emitted between the grid and plate could be photographed and the potential determined at which a given radiation appeared. This method is probably the most accurate of those described.

Recently some work by Gibson and Noyes[7] has shown that in most cases the potential required to produce luminosity in a gas, using a heated cathode, is a simple integral multiple of the ionization potential. According to the theory advanced, it is necessary for positive ions produced in the discharge to reach the cathode in order for the glow to be maintained. The fall of potential in the region between the cathode and the positive column is small, so that the electrons are accelerated in a comparatively short distance. If there are several ionization regions they will be relatively close together. As the potential between the two electrodes is diminished the slowest moving positive ions will be the first to fail to reach the cathode, etc. When all of the positive ions combine with electrons before they reach the cathode, the glow disappears. This will occur when the positive ions formed in the ionization region nearest the anode no longer have sufficient velocity to reach the cathode. The voltage necessary to maintain the glow will, therefore, be equal to the energy of the electron when it arrives at the last ionization region plus whatever energy it may have lost due to inelastic impact before it reaches that point. By studying the disappearance voltage at various pressures with various length tubes it is possible to obtain various multiples of the ionization potential. Subtracting successive values will give the potential desired. Care must be taken in interpreting results obtained by this method, since various combinations of resonance and ionization potentials may be obtained.

The exact method by which the energy of the impinging electron is transferred to the atom is not clear. Whittaker[8] has recently made an attempt at an explanation, but the whole question is in an unsettled state. One fact stands out, however, as a general survey of the field is made, namely, that the agreement between the observed ionization and resonance potentials and the theoretical values computed from spectroscopic data is excellent, leaving little doubt as to the validity of the relationship used.

A large amount of work has been done on hydrogen, due probably to the complete picture which Bohr has given of its atom. Many critical potentials have been noticed, but since the Bohr picture of the hydrogen molecule is apparently considerably in error, the exact interpretation of these potentials is still in doubt. The lowest radiating potential for the hydrogen atom, according to the Bohr theory, should be 10.2 volts. A critical potential of this order of magnitude has been observed by several workers, but, as has been pointed out by Foote and Mohler, there would scarcely be enough monatomic hydrogen present to give this value. The ionization potential of the atom, according to Bohr, should be 13.5 volts and recently Duffenback,[9] by using hydrogen at sufficiently high temperatures, has shown that this value coincides well with experiment. Bohr states that elimination of one electron from the hydrogen molecule without dissociation would leave an unstable ion. There is some evidence, although not at all conclusive, that ionization does occur according to this mechanism. The main ionization potential of hydrogen should occur, however, when the hydrogen molecule is dissociated and one of the two atoms ionized. The heat of dissociation of hydrogen, as determined by Langmuir,[10] is 84,000 calories, which corresponds to 3.6 volts. The main ionization potential of hydrogen should be, therefore, 13.5 + 3.6 = 17.1 volts. This potential has been observed by certain workers, while other workers have obtained lower values. A second ionization potential has been observed in the neighborhood of 30 volts. This would be obtained by the dissociation of the molecule and ionization of both of the atoms. There is some evidence that this is the principle ionization process in hydrogen in long tubes. The difficulty of interpreting the critical potentials in this case is largely increased due to the fact that the gas is diatomic.

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[6] *Phil. Mag.*, 42, 1002, 1921.

[7] *Jour. Amer. Chem. Soc.*, 44, 2091, 1922.

[8] *Proc. Roy. Soc. Edinburgh*, 42, 129, 1922.

[9] SCIENCE, 55, 210, 1922.

The variation of ionization potential with atomic weight for the elements of the first two groups of the Periodic System is approximately what one would predict. The most electropositive elements occur at the bottom of the periodic table and they have the lowest ionization potentials. Little success has been attained in measuring the ionization potentials of the elements in the center of the table. Those which lend themselves to study due to their ready vaporization exist as polyatomic molecules and the interpretation of the critical potentials is exceedingly difficult. Of the so-called electronegative gases, iodine is the only one which has been studied sufficiently to warrant our drawing any conclusions. It would seem that the principle ionization potential of iodine is about 10.0 volts, corresponding to the dissociation of the molecule and ionization of one of the atoms. Since the energy required to dissociate the molecule is 1.6 volts, the ionization potential of the atom should be 8.4 volts. This would correspond to a wave length of 1470 A., but sufficient spectroscopic data are not available to verify this measurement. It is interesting to note that Compton and Smyth[11] have obtained a lower ionization potential for fluorescing iodine than for normal iodine. This agrees with accepted principles, since the fluorescing molecules should be in an unstable state.

Bohr has pointed out that the ionization potentional is not necessarily a function of the electropositive or electronegative character of the elements, but depends on the configuration of the atoms.

The ionization potentials of several compounds have been measured, but it is doubtful whether the data are reliable in many cases. Many compounds are completely dissociated into their elements by electronic bombardment, and the value of the ionization•potential as measured may be due to any one of several possibilities. In general the ionization potential of an atom will be different from that of the same atom in combination. It would seem that further careful investigation in this field should be carried out, as it might give us an insight into the real nature of chemical combination.

Foote and Mohler[12] have studied the ionization potential of hydrochloric acid gas and find that it corresponds to simply disrupting the HCl molecule into H^+ and Cl^-. This ionization potential is lower than would be expected, due to the tendency of the chlorine to hold an electron, or in other words to its electron affinity. This agrees well with the idea that HCl is a polar compound.

An atom should be ionized by absorbing radiation of the proper wave length, namely, the same wave length as would be emitted by the reverse process. It may also be ionized by absorbing successive resonance radiations. The principal question before the photochemist at present is whether the action of light is to remove electrons and render the atoms or molecules more "active" or whether they are rendered "active" by displacement of the electrons to different orbits without ionization. It is probable that the rate of reaction of the "active" molecules is extremely rapid, and that the speed of a photochemical reaction depends to a large extent on the speed of ativation. It is impossible to say, at the present time, whether the action of light in chemical reactions is to remove electrons, but it seems probable that this is true in at least some cases. If this is the case, the radiation emitted by a positive ion combining with an electron should be the most efficient in aiding a photochemical action involving the same atom. Here again the problem is complicated if polyatomic molecules are considered. Radiation emitted by a hydrogen atom would probably be without effect on a hydrogen molecule. It has been shown that hydrogen is not activated in the Lyman region. It has been suggested that the study of band spectra might aid in the understanding of this field. Atoms are extremely accurately tuned systems and might not respond to radiation differing in frequency by one part in ten thousand. Whether the same holds true for molecules remains to be determined.

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[10] *Jour. Amer. Chem. Soc.*, 37, 417, 1915.

[11] *Phys. Rev.*, 16, 501, 1920.

[12] *Jour. Amer. Chem. Soc.*, 42, 1832, 1920.

Reactions involving the halogens are peculiarly photosensitive. This may be due to the electron affinity of the halogens, especially in the monatomic state. It is rather difficult to understand why a diatomic halogen molecule should have an electron affinity, and there may be room for difference of opinion on this point. The atoms tend to take up electrons in order to complete their outer shells. The theory at once suggests itself that the effect of light is to disrupt the bond between the halogen atoms, permitting them to combine readily with substances having less electron affinity. As Nernst[13] has suggested, the fact that these reactions do not obey the law of photochemical equivalents can probably be attributed to the fact that one free chlorine atom is formed each time a molecule of chlorine reacts and that this free chlorine atom may disrupt a molecule of the other reacting substance leaving another unstable intermediate product. This series could be continued indefinitely until it came to an accidental end. He tried the use of acceptors in the case of bromine for the purpose of removing the free bromine atoms and found that the law of photochemical equivalents was then obeyed.

In conclusion, it may be stated that while the work done in the field of ionization and resonance potentials has done much to aid our ideas of atomic structure, it has done little from the standpoint of chemical combination. We may look for its development along these lines in the future.

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[13] *Z. Elektrochem.*, 24, 335, 1919.

ARTHUR LALANNE KIMBALL

ALTHOUGH Professor Kimball had been in delicate health for several years, and his friends knew that before long he would have to retire from active teaching, the end came with little warning. On the afternoon of October 21 he worked as usual at the laboratory. In the early evening of the following day he passed away.

He was born at Succasunna, N. J., October 16, 1856. Graduating from Princeton in '81 with high honors, he won the experimental science fellowship and was a graduate student and fellow in physics there the following year. From 1882 to 1884 he was fellow at Johns Hopkins, working under Professor Rowland. Here he received in 1884 his doctor's degree, having completed a research on the absolute determination of the ohm. Immediately thereafter he was appointed associate in physics at Johns Hopkins. In 1888 he became associate professor and filled this position with distinguished success until 1891, when he was called to Amherst. Here a new laboratory was built under his direction and for thirty-one years to the day of his death he was conspicuous for ability, friendliness and whole-hearted devotion to the college.

It is probable that his Princeton classmates could have predicted pretty accurately his future. When a man of keen intellect and indomitable will starts in a certain direction his course can be charted in advance. One who knew him intimately writes: "Since the excellence of his moral character, in purity, sincerity, kindness and courage was as marked as his intellectual ability, his studious habits did not keep him out of friendly touch with his classmates, and he shared in our affection no less than in our admiration." At Johns Hopkins his knowledge, his simplicity, honesty and kindliness endeared him to all. With self-sacrificing consecration and high ideals he entered upon his work at Amherst. His clear thinking was matched by his gift for clear expression, and this fact was appreciated by his students. One of them on coming out of one of Professor Kimball's strikingly beautiful lectures on polarized light was heard to exclaim in a voice of mingled awe and admiration, "Say, fellows, I've sometimes paid good money for a lecture no better than that." A genuine compliment though a bit crude in form. Considerate of all but himself, Professor Kimball overestimated the ability of his body to stand the strain. Repeated sojourns in the Adirondacks served only temporarily to improve his impaired health. But against this background of physical ill his qualities of mind and heart shone with increased lustre. He showed courage akin to that of a wounded soldier on a field of battle. When strength was gone by force of will he carried on.

But the profound influence which this man everywhere wielded is not to be accounted for by gifts of intellect and charm of manner. Just as our physical weight depends partly on what is in us and partly on the planet under us, so a man's moral weight depends largely on the star toward which he strives; and no sketch of Professor Kimball, however brief, should omit mention of the fact that he was a religious man in every fiber. He believed in the church and helped in its work. His was an abundant, beneficent life, and while he enjoyed to the full that which is seen and temporal his character was built on the granite foundation of a faith in things unseen and eternal.

JOSEPH O. THOMPSON

SCIENTIFIC EVENTS

EXECUTIVE BOARD OF THE AMERICAN ENGINEERING COUNCIL

MANY problems of prime importance to the nation and to the engineering profession will be considered by the Executive Board ot the American Engineering Council, governing body of the Federated American Engineering Societies, at its next meeting, which has been fixed for March 23-24 in Cincinnati.

The board's sessions will be held at the Ohio Mechanics Institute, President Mortimer E. Cooley presiding. On March 22 the committee on procedure will meet at the Hotel Gibson. Arrangements are under way for a meeting of Cincinnati engineers on the evening of March 23 at which addresses will be delivered by members of the executive board. The opening session of the board will be called at 9:30 A.M., to be followed by an afternoon session at 1:30.

Considerable additions to the membership of the Federated American Engineering Societies are in prospect, President Cooley informed the committee on procedure at its last meeting in New York City. At least a dozen engineering societies are about ready to join, he said. President Cooley was authorized to appoint a committee on increase in membership. John A. Stevens, of Lowell, Mass., has been selected as chairman.

The meeting of the committee on procedure was presided over by President Cooley and was attended by Vice-presidents Philip N. Moore, J. Parke Channing, Calvert Townley and Gardner S. Williams, S. H. McCrory, chairman of the finance committee, and Executive Secretary L. W. Wallace.

President Cooley was authorized to appoint a committee on transportation to advise the executive board at its Cincinnati meeting as to whether or not there are any points in the problems of the transportation of the United States to which the federation could with propriety and effectiveness give attention, and if so, to submit a plan in its report to the executive board.

Max Toltz, of St. Paul, was chosen chairman of the transportation committee. Other members include Con M. Buck, W. H. Hoyt, W. K. Hatt, Dean Perley F. Walker and J. S. Barelli.

The committee on procedure decided that the entire question of immigration was without the purview of the federation and that a committee could not properly be appointed to study any phase of it.

Acting upon representations from the Associated General Contractors of America, to the effect that the seasonable aspects of the building industry as well as climbing construction costs were problems constituting an alarming situation, the committee adopted a resolution "viewing with approval the proposed cooperative movement to remove or reduce the element of seasonable demand in the construction industry."

Willingness to name a committee to cooperate with some responsible agency that will direct the movement was expressed. President Cooley was authorized to appoint a committee, should he believe it necessary, to cooperate with some authoritative instrumentality such as the American Construction Council or the Associated General Contractors of America.

A "buyers' strike" is inevitable if the present trend of higher prices continues, it was asserted in the statement of the contractors, signed by Managing Director Richard C. Marshall.

The committee on procedure decided that the American Engineering Council would aid in any way within its power and means in bringing about uniform safety legislation. The committee declined to take a stand on the ship subsidy bill, which, it was held, did not come within the scope of the federation's activities.

A communication from W. S. Moody stating that immigration restrictions have so handicapped production that the nation's commercial growth was being hampered was considered by the committee. Suggesting that machinery be used to relieve the shortage of unskilled labor, Mr. Moody said:

> I offer for your consideration the proposition that the council make a thorough survey of industry and select several kinds of work now done manually where great numbers of men could be replaced if power driven devices did the work.
>
> Having selected sufficient fields of such work to release say 500,000 or more hands, I would then have the council recommend to all industry that they associate for this purpose and contribute the necessary money to enable various suitable engineering organizations to undertake the development of the necessary devices for performing this work.
>
> The developmental work should be undertaken by the engineering organization in the same intensive way that similar big production problems were taken up during the war, although, of course, with greater regard for reasonable economy.

The committee voted to submit the question of undertaking an intensive study of labor-saving devices, as outlined by Mr. Moody, to the American Society of Mechanical Engineers.

APPOINTMENTS IN THE U. S. BUREAU OF MINES

CONTINUED growth of the Bureau of Mines, especially in the supervision of leasing operations on public lands, has resulted in the creation of a leasing branch within the bureau, the appointment of another assistant director and several changes of personnel within the organization.

General operations under the leasing act of February 25, 1920, development of lands in the naval reserves and the supervision of operations on Indian lands, have combined to make the federal government an outstanding factor in the production of minerals. Wells drilled on public lands, including the naval reserves, now produce approximately 3,000,000 barrels of oil monthly, or at a daily rate of 100,000 barrels. This production is outside of that from Indian lands. Coal leases and prospecting permits have been issued in fourteen western states, in which the federal government is supervising the operation of eighty-nine mines.

A. W. Ambrose, assistant director, who is specially qualified in petroleum matters, has been placed in charge of the newly created leasing branch. He also will act as a consulting engineer to all branches of the bureau on matters relating to petroleum and natural gas.

D. A. Lyon, chief metallurgist and supervisor of stations, has been appointed assistant director in charge of the research branch, which includes the functions and scope of the former investigations branch after the elimination of leasing matters. For the present, no appointment will be made to the position of supervisor of stations and Mr. Lyon will perform the duties of supervisor in addition to those of head of the research branch.

T. T. Read, having asked to be relieved from his position as chief of the information service and assigned to investigative work, has been appointed a supervising mining engineer. During the absence of F. J. Bailey, assistant to the director, on a visit to the mine safety cars and stations, Mr. Read will serve as the acting head of the operations branch of the bureau and will later be assigned to appropriate field duties.

C. E. Julihn has been recalled from service as chief mining engineer of the War Minerals Relief Commission and made chief of the information service. Francis Winslow, now connected with the division of war minerals supply, has been assigned to serve with the War Minerals Relief Commission as its chief engineer. J. W. Furness, who has been working with the war minerals supply division of the Bureau of Mines, has been given a permanent appointment in that division.

These changes and appointments are effective as of March 1, 1923.

GRANTS FROM THE ELIZABETH THOMPSON SCIENCE FUND

THE following awards were made at the meeting of the trustees of the Elizabeth Thompson Science Fund on February 24:

No. 241. To Dr. E. Wiedemann, Physikalisches Institut, Universität, Erlangen, Germany, $100 for researches on physical properties of colloidal substances.

No. 242. To Dr. B. Lipschütz, Paltauf's Pathological Institute, Vienna, Austria, $150 for studies of the experimental tar cancer of the mouse.

No. 243. To Mr. A. H. Palmer, U. S. Weather Bureau, San Francisco, California, for maps and photographs.

No. 244. To Dr. E. F. Adolph, Zoological Laboratory, University of Pittsburgh, Pittsburgh, Pa., $250 for electrical equipment.

No. 245. To Dr. Frank A. Hartman, Physiology Laboratory, University of Buffalo, Buffalo, New York, $200 for studies of adrenal function.

No. 246. To Professor James B. Conant, department of chemistry, Harvard University, Cambridge 38, Mass., $150 for a study of a new method of comparing the reactivities of a series of organic chlorides.

No. 247. To Professor C. T. Brues, Bussey Institution, Harvard University, Forest Hills, Boston, Mass., $100 for a study of certain phytophagic races of insects.

No. 248. To Professor G. H. Parker, Museum of Comparative Zoology, Harvard University, Cambridge, Mass., $200 for the study of nerve respiration.

The Elizabeth Thompson Science Fund is administered by G. H. Parker, president; E. B. Wilson, secretary; Charles S. Rackemann, treasurer, and G. P. Baxter and W. B. Cannon, members of the board of trustees. The trustees meet three times a year toward the end of February, of May and of November. Applications should be in the hands of the secretary well in advance of the date of the meeting.

GIFT TO THE ROYAL SOCIETY

SIR ALFRED YARROW, an engineer and shipbuilder of Glasgow, has given £100,000 to the Royal Society for reasons and under the conditions stated in the following letter, addressed to the president:

I would ask you to be so kind as to bring before the council, at an early opportunity, the following proposals:

I have, for many years, held the view that the prosperity of this country has been greatly hampered in the past for the want of better promotion to scientific investigation and its application to practical affairs.

I am convinced that the future prosperity of this country will be largely dependent upon the encouragement of original scientific research. The birth of new industries, and the development of existing ones, are due largely to the growth of science, thus securing employment and the welfare of the whole community being advanced.

It is doubtful whether even yet it has been realized how completely this country would have been at the mercy of our antagonists in the late war, had it not been for the research work done by our scientific men before the war and during its course.

I desire to mark my sense of the value of research to the community by offering, as a gift to the Royal Society, £100,000 to be used as capital or income for the purposes of the society, as the council may think fit, because I recognize conditions alter so materially from time to time that, in order to secure the greatest possible benefit from such a fund, it must be administered with unfettered discretion by the best people from time to time available.

Care must, of course, be taken that a gift from the fund shall in no case lessen any government grant.

In accordance with your practice you would, I assume, appoint a committee to administer the fund, and would also frame rules for the guidance of the committee, while reserving the right to alter such rules from time to time; and I would suggest that they be considered by the council every tenth year so as to meet modern needs.

I should prefer that the money be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than to erect costly buildings, because large sums of money are sometimes spent on buildings without adequate endowment, and the investigators are embarrassed by financial anxieties.

Although I thus give a general expression of my wishes, I do not intend, by so doing, to create any trust or legal obligation for their fulfilment.

In conclusion, I should like to record my firm conviction that a patriotic citizen can not give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends.

THE ENDOWMENT OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

MR. ARTHUR H. FLEMING, of Pasadena, for many years president of the board of trustees of the California Institute of Technology and its chief financial supporter, has recently given to the institute his fortune of $4,200,000 as a permanent endowment fund. This gift, with Mr. Fleming's previous donations to the institute, make a total of over $5,000,000. In the trust agreement entered into upon the turning over of this fund, Mr. Fleming has made the following statement of his own ideals for the institute:

> The donor is convinced that the institute can best serve the purposes of its existence if its trustees adhere to certain fixed policies and principles, and he therefore earnestly advises and recommends:
>
> That the institute limit its enrollment to not more than two thousand (2,000) students;
>
> That it continue the work it is now doing in the several branches of engineering;
>
> That it specialize in research in chemistry and physics, under the direction of the most competent men obtainable, with the most liberal provision, in the way of salaries and equipment, for the prosecution of such work;
>
> That it seek and invite the superior student;
>
> That it help and encourage those who are disposed to research, but that the utmost care be exercised in the manner of giving such help and encouragement, keeping always in mind that ill-advised or too free-handed assistance begets weakness rather than strength, and that a man should be helped to help himself;
>
> That it use every proper effort to obtain generous endowment funds, to the end that it may be able to make adequate provision for the effective prosecution of research work, pay good salaries to its faculty and obtain the services of educators of the first order; and, lastly,
>
> That it keep its standards of the highest.
>
> The donor is also convinced that the institute should always remain a privately endowed institution.

SCIENTIFIC NOTES AND NEWS

THE executive committee of the American Association for the Advancement of Science recently elected the following vice-presidents of the association for the year 1923, these elections not having been made at the recent Boston meeting: For section L, Dr. Florian Cajori, professor of the history of mathematics, University of California. For section N, Dr. Richard P. Strong, chief, department of tropical medicine, Harvard University Medical School. For section Q, Dr. Henry W. Holmes, dean of graduate school of education, Harvard University.

PROFESSOR LEON J. COLE, of the University of Wisconsin, has been appointed chief of the division of animal husbandry of the U. S. Department of Agriculture.

THE Boylston medical prize of $300, offered every other year by the Harvard Medical School in public competition for the best essay on a subject in medical science, has been won by Professor A. N. Richards and Dr. Joseph T. Wearn, both of the University of Pennsylvania.

THE University of Pennsylvania conferred the degree of LL.D. on Dr. Chevalier Jackson, professor of bronchoscopy and esophagoscopy in the graduate school of medicine of the university, at the ninety-eighth annual observance of Washington's birthday on February 22.

A DINNER in honor of Dr. G. Edmund de Schweinitz, Philadelphia, president of the American Medical Association, was given by the Chicago Ophthalmological Society on March 6.

DR. SWALE VINCENT, professor of physiology in the University of London, has been elected a member of the Paris Academy of Sciences in place of the late Professor Laveran.

THE Weldon memorial prize, which was founded at the University of Oxford in 1907 by friends of the late Professor Weldon, to perpetuate his memory and to encourage biometric science, has been awarded to Dr. Johannes Schmidt, director of the Carlsberg Laboratory, Copenhagen.

PROFESSOR BORDET, of Brussels, director of the Pasteur Institute of Brabant, has been made a commander of the French Legion of Honor.

DR. CHARLES H. TOWNSEND, director of the New York Aquarium, formerly connected with the deep-sea investigations of the steamship *Albatross,* has been elected a member of the council of the Oceanographic Institute, founded by the late Prince of Monaco.

AT the recent meeting of the American Institute of Mining and Metallurgical Engineers, E. P. Mathewson was made president; T. T. Brewster, of St. Louis, vice-president, and Frank H. Smith, of Spokane, second vice-president. The directors elected are W. H. Aldridge, of New York City; G. H. Clevenger, of Brookline, Mass.; A. N. Diehl, of Pittsburgh; Reno H. Sales, of Butte, Mont., and Seeley W. Mudd, of Los Angeles.

THE following officers of the Royal Astronomical Society were elected at the meeting on February 9: *President,* Dr. J. L. E. Dreyer; *vice-presidents,* Professor A. S. Eddington, Sir F. W. Dyson, Mr. E. B. Knobel and Professor H. F. Newall; *treasurer,* Lieutenant Colonel F. J. M. Stratton; *secretaries,* Mr. H. Spencer Jones and Rev. T. E. R. Phillips; *foreign secretary,* Professor H. H. Turner.

JOHN MORRIS WEISS, consulting chemical engineer, New York, has been selected by the Manufacturing Chemists' Association to serve as their representative on the recently formed sub-committee on benzol poisoning of the chemical section of the National Safety Council.

DR. VICTOR YNGVE has resigned his position with the Hydrol Company, Niagara Falls, N. Y., to accept a research fellowship in cryogenic engineering at Harvard University.

E. L. RIMBAULT, formerly reclamation manager of the National Aniline and Chemical Company, Inc., at the Buffalo plant, has been appointed manager of the intermediates and certified food color divisions.

DR. SIMEON B. WOLBACH, of the Harvard Medical School, Boston, and Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, New York, are conducting at Hamilton, Montana, research work on Rocky Mountain spotted fever. Their work will continue for several months.

PROFESSOR REID HUNT, of the Harvard Medical School, has been appointed visiting professor at the Peking-Union Medical College.

DR. HANAU W. LOEB, dean of the St. Louis University School of Medicine, sailed from San Francisco on February 22 for a tour of the Orient. During his trip Dr. Loeb will visit the medical schools of Japan, China and the Philippines.

PROFESSOR WILLIAM H. HOBBS, of the University of Michigan, will attend the Pan-Pacific scientific congress to be convened at Sidney and Melbourne, Australia, from August 13 to September 4, by special invitation of the Australian government. He will deliver several papers on the topic of Pacific geology. In his absence Dr. Jesse P. Rowe, professor of geology at the University of Montana, will serve as the head of the department during the summer session.

PROFESSOR THE. SVEDBERG, University of Upsala, Sweden, who is conducting classes in colloid chemistry in the University of Wisconsin chemistry department during the second semester this year, has been invited to attend the dedication ceremonies of the Sterling chemical laboratory at Yale University on April 4.

THE new research laboratories of the General Electric Company, Ltd., Wembley, England, were opened on February 27, when Lord Robert Cecil and Sir Joseph Thomson delivered inaugural addresses.

A JOINT meeting of the Washington Academy of Sciences and the Philosophical Society of Washington was held on March 10, at which Professor A. Sommerfeld, of Munich, delivered an address on "Evidence for the theory of relativity afforded by atomic physics."

DR. LEON ASHER, professor of physiology at the University of Berne, Switzerland, delivered a series of lectures on "The physiology of the lymphatics" at the St. Louis University School of Medicine from March 5 to 9.

PROFESSOR ROSS G. HARRISON, of Yale University, recently gave two lectures on "The life of the tissues outside the body" before the University of North Carolina chapter of the Sigma Xi.

MR. FRANCOIS E. MATTHES, of the United

States Geological Survey, gave an illustrated lecture before the New York Academy of Sciences at its general meeting of March 5 on the "Evolution of the Yosemite Valley." He also spent a day at the American Museum of Natural History inspecting the new large relief model of the Yosemite Valley that is being prepared under the direction of Dr. E. O. Hovey.

PROFESSOR C. J. CHAMBERLAIN, of the University of Chicago, delivered on March 3 an address at Toronto to the Royal Canadian Institute on the subject "Ancient plants."

PROFESSOR F. S. HAMMETT, of the Wistar Institute of Philadelphia, delivered a lecture before the Royal Canadian Institute at Toronto on February 24 on "The glands of internal secretion and their functions."

DR. CHRISTINE LADD-FRANKLIN, of Columbia University, gave an illustrated lecture on January 23 at Harvard University under the auspices of the department of psychology, on "Theories of color sensation."

DR. HARRY HARKNESS STOEK, since 1909 professor of mining engineering, University of Illinois, died suddenly on March 1, aged fifty-seven years.

PROFESSOR JOHANNES DIDERIK VAN DER WAALS, of the University of Amsterdam, died on March 8. Dr. Van der Waals received the Nobel prize for physics in 1910.

WALTER WILLIAM BRYANT, senior assistant in charge of the magnetic and meteorological department of the Greenwich Observatory, died on January 9, at the age of fifty-eight years.

ALFRED HENRY FISON, lecturer on physics at Guy's Hospital, was killed while installing wireless apparatus at the hospital on February 4.

BERNARD BOSANQUET, a distinguished English writer on philosophy and logic, died on February 8, at the age of seventy-five years.

THE death is announced of Gaston Bonnier, professor of botany at the Sorbonne, Paris.

IT has recently been brought to the attention of the council of the Harvard Travellers' Club that the rifle presented by the club to Mr. V. Stefansson in May, 1913, was stolen some time in October, 1914, probably from a wharf in Esquimalt, B. C. The rifle was a .256 bore Gibbs Magnum Mannlicher-Schoneaur, No. B 6029. Any information as to the present whereabouts of this rifle will be gratefully received and a suitable reward will be paid to the informant. Communications may be addressed to the president of the club, Professor Theodore Lyman, Jefferson Physical Laboratory, Cambridge, Mass.

THE United Civil Service Commission announces an examination for assistant in fisheries investigations in the service of the U. S. Bureau of Fisheries, to be held on April 4, 1923. Applicants will be rated chiefly upon general biology and zoology in relation to the fisheries. There are to be filled from this examination one position of field assistant in the Fisheries Service at large, at $1,200 per year; two positions of scientific assistant at $1,200, one at Fairport, Iowa, and one at the Washington, D. C., office; one in the position of fishery expert, in the steamer *Albatross*, at $1,400 per year, and vacancies in positions requiring similar qualifications at higher or lower salaries. All of these positions carry the present bonus of $20 per month. Applicants should apply to the Civil Service Commission, Washington, D. C., for form 1312, stating the title of the examination desired.

THE French Société de biologie will celebrate its seventy-fifth anniversary on May 26. Delegates are expected from its affiliated societies, seven in France and one at Petrograd, Buenos Aires, Lisbon, Athens, Copenhagen, Bucharest, Cluj and Jassy, Stockholm and Lithuania and from the Société belge de biologie. Three questions have been selected for discussion: "Generation and fecundation," "Physiological action of potassium and calcium," and "Immunity in invertebrates."

THE thirty-fifth German Medical Congress will be held in Vienna from April 9 to 12, under the presidency of Professor K. F. Wenckebach, when there will be discussions on encephalitis lethargica, introduced by von Economo of Vienna and Nonne of Hamburg, and on high arterial blood pressure, introduced by A. Durig, of Vienna, and Volhard, of Halle. One afternoon will be devoted to demonstration of patients with endocrine disturbances.

THE Aztec ruin, near the town of Aztec, N. M., donated to the government by the American Museum of Natural History, is established as a national monument under a proclamation issued by President Harding. The prehistoric ruin which is thus placed under the jurisdiction of the National Park Service of the Interior Department, is the best preserved of all the ruins in that vicinity, and its designation as a national monument will assure its preservation to posterity. The ruin, one of the well-known Pueblo type, is a large E-shaped structure of approximately 500 rooms with the entire first story standing and many of the second floor rooms intact. The ceilings are supported by large beams, cut and dressed with stone tools, while the walls are of sandstone with dressed faces, and as examples of prehistoric masonry are said to take high rank. Excavation of the ruins has been carried out during the last five years by the American Museum.

THE *Journal* of the American Medical Association states that it is announced by Dr. Henry Hanson, director of public health for the Republic of Peru and of the Peruvian yellow fever campaign carried out by the Rockefeller Foundation and the government, that Peru is free from yellow fever for the first time in history. There have been no cases reported since August, 1921, so that practically the whole western coast of the Western Hemisphere may be said to be cleared of the disease.

THE British Industrial Fatigue Research Board has issued a report containing two documents, one, on the influence of temperature and other conditions on the frequency of industrial accidents, by Miss Ethel E. Osborne and Dr. H. M. Vernon, and the other, on the relation of fatigue and accuracy to speed and duration of work, by Mr. B. Muscio.

THE first of the William Beaumont Foundation lectures, given under the auspices of the Wayne County Medical Society, Detroit, has been issued in book form. Dr. W. G. MacCallum, professor of pathology in the Johns Hopkins University, delivered the first lecture. This series of lectures is the outgrowth of a patriotic fund created during the war for the purpose of assisting needy families of the medical society who were in war service. After the fund had served its purpose, the contributors redonated the substantial surplus to the progress of scientific medicine.

DR. CHAS. F. SHAW, professor of soil technology at the University of California, is taking a six months' sabbatical leave from February to August, and will visit the Hawaiian Islands for six weeks, proceeding to Australia with a brief stop at the Fiji Islands, returning through New Zealand, Raratonga and Tahiti. He is planning to observe soil condition in the Hawaiian Islands, particularly on the Islands of Hawaii, Oahu and Kauai, representing three very distinct stages in soil formation. In Australia he will study the character of the soils, particularly those of the new regions that may be opened up for settlement through the development of the Darwin and Murray rivers, and will also try to determine whether or not the soil zones that have been observed in Europe and on the American continent are developed on the Australian continent. Two weeks will be spent on the north island of New Zealand mainly in sightseeing. Dr. Shaw will bring back representative samples of soils from Australia both for the University of California and for the laboratory of the Bureau of Soils at Washington.

AT a recent meeting of the Board of Regents at the University of Michigan the president of the university filed a statement from Professor A. G. Ruthven with regard to the anthropological expedition to the Philippines. Dr. Guthe, the director of the expedition, wrote: "The collection already at hand is far beyond my wildest dreams. The unbroken pieces alone number well over one hundred. There are undoubted specimens of T'ang, Sung, and Ming ware. The possibility for comparisons and study in these wares alone overwhelms me. In addition to Chinese ceramics there are unglazed pieces, and a goodly amount of beads, implements, skeletal material, wooden objects, etc. Gold and iron is not uncommon. We know at present of at least thirty caves and ten burial grounds which are more than likely to yield results. The islands seem to be full of the stuff."

THE *Journal* of the American Association reports that the Academy of Medicine at Paris has fifty-nine endowed prizes to award in 1922, and 133 articles were received in competition. This year again the secretary commented on the handicap resulting from too specific directions in regard to the awarding of a prize, as conditions change rapidly from year to year. During the year, two new prizes were endowed: one pertaining to questions of general hygiene and the other to the medical treatment of facial neuralgia. The Herpin prize, for the "Abortive treatment of poliomyelitis," was awarded to Dr. A. Pettit of the Pasteur Institute, for his results with his antipoliomyelitis serum. He takes for the antigen the virulent medulla of monkeys. This year again the Audiffred prize "for a sovereign remedy for tuberculosis," consisting of a 3 per cent. government bond and representing an income of 24,000 francs, was not awarded, although six competing works were received. Nineteen of the prizes were not awarded; no competing articles were received for four of them. The recipients of the prizes were all physicians in France or the French colonies, with the exception of Professor C. Pezzi, of Milan, who shared with Laubry of Paris a prize for their "Manual on congenital heart disease." All but ten of the prizes are open to international competition.

THE Kaiser Wilhelm Institute for medicosocial education, which was formerly the Kaiser Wilhelm Academy for the advancement of military medicine, is to be transformed into a government institute for medical research. This institute, which was completed a few years before the war, is to turn over its excellent laboratories and its library, which is probably the largest medical library in Germany, to the service of scientific medical investigation.

R. B. MARSTON, editor of *The Publishers' Circular and Booksellers' Record,* London, writes to the London *Times* as follows: "With reference to the letter from Miss Charlotte Mansfield stating that a number of German publishers refuse to sell their chemical books to non-Germans, I am informed by authorities in the German book trade in Leipzig and Berlin that Miss Mansfield has been misinformed. There is no ban on the export of German works on chemistry or any other subject. Every German publisher is very glad to sell his books—chemical or other—to non-Germans; but what may have given rise to the idea of refusal to export is that, owing to the great fall in the exchange value of the mark, German publishers are compelled to put a surcharge of 200 per cent., more in some cases, on copies exported to England and other countries. The German government supports the efforts of the book trade to protect itself in this respect, and customs officials at the frontiers are instructed to see that the surcharge is made. German publishers of expensive scientific works insist on a declaration in writing that purchasers in Germany will not export the works unless this surcharge is made—even then the cost to the English or other importer is still very low. During the war suggestions were made that some restraint should be put after the war on the world-wide dissemination of German science, but beyond this surcharge, which applies to books of all kinds, nothing has been done in this direction. I have experienced no difficulty in getting German military and technical works and find them, in spite of the surcharge, cheaper than before the war in most cases."

UNIVERSITY AND EDUCATIONAL NOTES

THE site at Woodland Avenue and Forty-second Street, Philadelphia, for the new buildings of the Philadelphia College of Pharmacy and Science, was dedicated February 23. Rear Admiral Braisted, former surgeon general of the navy and president of the college, delivered the dedicatory address. It was announced that more than $1,000,000 had been collected since last November in the campaign for $2,000,000 for the erection of buildings. The college was founded by Benjamin Franklin.

THE department of bacteriology of the University of Chicago will occupy this month its new laboratory, to be known as "Ricketts Laboratory South." Ricketts Laboratory South is a fireproof building, one story in height, situated a few yards to the south of Ricketts Laboratory, and has been erected at a cost of $50,000. Like Ricketts Laboratory, it bears the name of Howard Taylor Ricketts, assistant professor in the university, whose researches in typhus fever led to the discovery of the remedy for that great scourge, and who lost his life in Mexico City in May, 1910, from the fever which he was engaged in studying.

WE learn from the *Journal* of the American Medical Association that a campaign was opened in December in the United States to raise funds for the medical schools for women in India, China and Japan, which, if secured, would insure a gift of $500,000 from John D. Rockefeller. Dr. Tehyi Hsieh, Dr. Ida Scudder, principal of the Women's Medical College, Vellore, India, and Dr. Mabel M. Manderson, former dean of the North China Medical College for Women, Peking, toured the United States lecturing for this movement. It was announced recently by the Woman's Foreign Missionary Society of the Methodist Episcopal Church that more than $2,800,000 had been raised for the six oriental colleges for women.

ASSOCIATE PROFESSOR C. M. SPARROW, of the University of Virginia, has been promoted to a full professorship of physics.

AT the University of Cambridge, Mr. J. B. S. Haldane, New College, Oxford, and Trinity College, has been appointed Sir William Dunn's reader in biochemistry, Mr. A. Hutchinson, Pembroke College, university lecturer in crystallography, and Dr. C. Shearer, Clare College, university lecturer in embryology.

DISCUSSION AND CORRESPONDENCE

RADIATION A FORM OF MATTER: UNPROVEN

WHAT is there about relativity that compels so many of its expositors to confuse terms hopelessly, to fail to distinguish between definition and proof, to adopt a spurious logic that would never be countenanced in another connection? Can it all be accounted for by the mental confusion that usually attends the use of well-known words to denote ideas that are new and more or less foreign to those previously denoted by them? Questions of this kind arise on reading such articles as Professor A. H. Compton's letter entitled "Radiation a form of matter,"[1] in which he claims to have demonstrated "that, according to the common significance of the word, radiation must be considered as a form of matter."

His demonstration consists of two parts. First, he maintains that the existence of radiation pressure is proof that the radiation possesses mass; second, matter has been defined as "that which possesses mass or inertia"; hence radiation is matter.

That the first conclusion involves a logical fallacy should be evident to any one who is acquaintd with the thump that can be given by a compressional wave traveling along a spiral spring, even though he were unacquainted with the physics of the prerelativity era. The existence of radiation pressure shows that there is a transmission of momentum with the wave, but this does not require that the inertia concerned with this momentum pertains to and travels with the radiation.

As regards the second part of the demonstration, it should be evident that nothing new can be proven by a verbal definition. We are concerned with groups of phenomena, ideas, concepts, not with mere words. Definite words are chosen to denote definite groups of phenomena, ideas or concepts; and it is only as we comprehend these that we understand the true significance of the word.

If a word is used to denote but a single property, then its definition merely names that property; for example, "Energy is the capacity for doing work." Such definitions are equivalent to mathematical identities; having found that one of the two terms of the definition is applicable to a given case, it is a mere truism to say that the other is likewise applicable, it adds nothing whatever to our knowledge of the subject under consideration. Such definitions classify by means of a single property, connotate nothing, convey no implication either of similarity or of dissimilarity between other properties of the items that are grouped together by this classification.

If a word denotes, not a property, but a group of units each possessing many properties, some common to all units of the group, others differing from unit to unit, the proper conception of the significance of the word can be conveyed best in the manner employed in educating infants, by pointing out numerous diverse units belonging to the group. The verbal definition of such a word must be exceedingly complex if it is even approximately complete. In practise, the definition of such a word is designed to serve merely as an aid to classification, and consists in the naming of only a few properties, in many cases of but one, that appear to be common to all units of the group and to be possessed by no unit belonging to any other group, all other properties common to the several units being connotated only. Definitions of this connotative kind can never be regarded as final, nor be used to prove that a given unit is properly designated by the word defined. If the properties of the unit in question are such as to conflict with the connotations of the definition, then the proper conclusion is that the verbal definition is unsatisfactory, that it does not serve to distinguish unambiguously from other units those of the group designated by the word defined. To adopt any other policy is to deny that there is any connotation, to claim that the word merely designates the property or properties named in the definition; in other words, to claim that the definition is of the kind previously considered.

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[1] SCIENCE, 52, 716, December 22, 1922.

As commonly used, "matter" and "material" denote a group of units that possess many properties; verbal definitions of them must be connotative. This appears to be recognized by Professor Compton. The use he makes of the definition is therefore invalid. In order to establish his thesis, he must show, by other than an appeal to verbal definitions, that radiation is indeed a unit of the group denoted by the word matter, that it satisfies the connotative demands.

In the first paragraph of the letter we find the expressions "conservation of matter," "conservation of mass" and "mass or inertia." The terms matter, mass, inertia appear to be regarded as synonymous. Certainly the concepts designated by "matter" and by "inertia" are quite distinct. The terms matter and material, as commonly used, refer to aggregations of what we are pleased to call atoms. Such aggregations have been found to possess both weight and inertia. It is the first of these, the one that determines the value of *m* in the gravitational equation, that has been found experimentally to be conserved. The second term, inertia, determines the work that is required to give the aggregation a specified velocity. The two concepts are quite different and should not be confounded. Experiments indicate that the ratio of the weight of such an aggregation to its inertia is a universal constant, the same for all such aggregations; but it should not be forgotten that this truly surprising relation has been established solely for aggregations of atoms. I know of nothing that will justify the conclusion that the possession of inertia universally implies the possession of weight. When these different concepts are kept clearly distinct, the difficulty of establishing the proposed thesis is increased. In truth, the thesis in general appears untenable.

If the words "matter" and "inertia" are redefined as identical concepts denoting a single property the quantity of which differs from energy by only a universal constant, then, and probably only then, can the thesis in general be maintained.

Redefinitions appear to be essential to the relativity theory, but they are in general unavowed and unrecognized by the expositors of that theory. Terms so redefined do *not* denote the same concepts as they did before, and much of the utter nonsense that has been written about relativity is attributable to a failure to recognize the differences so introduced. Is it superoptimistic to hope that in the near future expositors of relativity will consider carefully and inform their readers of the actual significance of the terms they use? Care in this respect, combined wih the elimination of inconclusive and invalid arguments, will be of great service to both the physicist and the layman. Incidentally, it will reduce the volume of relativity literature that one has to read; but that need not be considered here.

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RIGHT AND LEFT HANDED SPEAKERS

The subject of right and left handedness periodically has evoked interesting discussion in the columns of Science, but I do not recall mention of a fact which I frequently have verified by observation, namely, that there are right and left handed speakers. Given an audience hall of oblong dimensions where the speaker stands in the center of one side and not at the end, unless he be a practiced speaker he usually will address the majority of his remarks, be they written or impromptu, towards one or the other end of the hall, depending upon whether he be right or left handed. In illustration, I recently listened in a hall of this description to two cultivated Englishmen. One was an orator accustomed to speak in the House of Parliament, where the audience surrounds the speaker on all sides. He turned equally to the right and left of his audience, but the other, a general, more accustomed to the battlefields than the rostrum, gesticulated with his right hand so forcefully that he pulled himself around to face his audience upon his right, to the almost complete ignoring of those seated upon his left. Meanwhile, in his embarrassment, with his left hand he clung to the lapel of his coat, which further precluded his turning towards that side!

In a medical lecture hall into which an adjoining room often is thrown open to accommodate an overflow audience, there is a narrow but tall reader's desk at the center of one side. It is amusing to note that the right-handed speaker often leans upon this desk with his right arm, thereby turning himself to address his audience upon his left, but should he remove his right arm to gesticulate (which medical speakers from the nature of their subject rarely have occasion to do), he pulls himself around to face the opposite end of the wide but narrow hall. The left-handed speaker does the reverse. As the majority of speakers are right handed, I have found it an advantage for hearing to sit in the audience upon their right side, unless there be a tall reading desk, when it is safer to sit upon their left!

Related to this topic is the question of right and left eyedness, which was discussed in SCIENCE some time ago. Apart from any question of possible difference in acuteness of vision is the fact that many persons can not close the two eyelids with equal facility, which sometimes may account for poor marksmanship. In sighting a shotgun, for instance, from the right shoulder, if one instinctively closes the right eyelid much more readily than the left, in order to use the left eye one must bring the head much further over toward the stock of the gun, and failure to do this quickly and completely results in poor aim, particularly in rapid firing, as in taking birds on the wing.

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THE BIRD COLLECTOR

FROM the article of Joseph Grinnell in your December 15th issue, one would infer, first, that the toll taken by collecting ornithologists is negligible; and second, that it makes no difference anyway since the factor of safety is so large. However true this may be with respect to the dominant species, it certainly is not so when it comes to forms that are rare, either absolutely or locally. When a species once gets on the down grade, the hand of every man with a gun, especially if he be an ornithologist, is against it. There is no deadlier adventure for a rare bird or one which has ventured out of its ordinary range than to meet a bird lover of the collecting type. One might think that the ornithologist-conscience would prevent abuses in this line, but my experience indicates that in this variety of the human species that mental organ is purely vestigial; while among commercial collectors, for whose existence the ornithologist is chiefly responsible, it is non-existent. For example, a few years ago a pair of avocets (formerly abundant, but now very scarce in western Nebraska) bred in a marsh near Grand Island. The following year, this colony was increased. The news of this brave attempt to regain some of its lost territory reached the ears of a collector in Lincoln, who promptly went out and exterminated the colony.

The last specimen of the British sea-eagle passed away not long ago. Paid persecution brought its numbers to the danger point; but after the reward for killing it was withdrawn, it might easily have maintained itself but for the selfishness of collectors, who shot every available specimen for "preservation." To this the scientific bird-man will doubtless reply: "Tush! When a species is dying out or trying to extend its range, it will do so regardless of collectors." But to the non-partisan mind such protests naturally raise a question as to the protestor's sincerity or accuracy. The indictment of Douglas Dewar anent the hoopoe will strike many a responsive chord. In his

Bombay Ducks, p. 146, he says, "The hoopoe frequently visits England and would breed there if it were allowed to do so; but the moment the beautiful bird sets foot on our shore it is shot by some collector, who then proceeds to boast about his exploit. The consequence is that the hoopoe is a very rare bird in England, and is likely to remain so until severe measures are enacted against that enemy of nature, the collector of birds."

What is to be done? As one who believes that for the greatest good to the greatest number, it is more important to save the rare birds than have them run the risk of extermination in the interests of science, I believe the killing of such birds should be absolutely prohibited. Their appearance can be taught by carefully prepared plates or by skins protected by double glass-plates. If any one believes that it is absolutely essential to human welfare or to that of his guild that they be "collected," let him show the faith that is in him by going after them and standing up for fine and imprisonment like a man. For the species that are beginning to be rare, or better yet, for all harmless birds the laws should permit them to be shot only by accredited representatives of scientific institutions. Furthermore, all teachers and others engaged in promoting the interests of young people in wild life should discourage the collecting impulse as unsocial in its ultimate results. To test the logic of this position merely imagine what the result of the opposite course would be. Suppose all children throughout the land were urged to provide themselves with guns and to start collections of birds and eggs. What would this do to the factor of safety for the rarer birds?

H. Gifford

THE ACTION OF SODIUM HYDRATE UPON THE COMPOSITION AND DIGESTIBILITY OF GRAIN HULLS

In an earlier publication of this journal,[1] a brief account was given of studies made at this station on the effect of dilute solutions of sodium hydrate on the composition and digestibility of grain hulls and other fibrous material.

Since this first report was made additional work has been done with barley hulls, cottonseed hulls and flax shives. It has been found that the soda solution had a pronounced influence in improving the digestibility of the barley hulls but that it was substantially without effect upon the digestibility of the cottonseed hulls or flax shives. A special study is being made of its action upon the digestibility of the pentosans, fiber and lignin. It is intended to study the effects of other methods of treatment including the action of other chemicals upon grain hulls and similar materials.

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STENOMORPH, A NEW TERM IN TAXONOMY

In the study of shipworms I have found that larval forms of various species seem to show no selective powers as far as the size of the wood to which they have attached themselves is concerned. It therefore happens that we find the same species growing in timbers sufficiently large to enable it to attain full size, which in different species varies from six inches to three and a half feet in length, and from a few millimeters to almost an inch in diameter; or the larval forms of the same species may attach themselves to a piece of lath or a twig and completely honeycomb this, just as they do the larger piece of timber, reaching sexual maturity in this state. Forms under such conditions are dwarfed and while they have the structural features of the larger species, these are all reduced correspondingly in size. To such forms distinct names have been given by some authors who did not understand the true inwardness of the situation. For such diminutive forms produced by their cramped habitat I wish now to propose the term *stenomorph*.

Specimens coming under this designation will probably be found in all species of shipworms as well as other boring and nestling mollusks and probably other groups of organisms.

It is more than likely that specimens grown in the small 2 x 4" test blocks, placed in various waters of our country by the Committee on Marine Piling Investigations of the National Research Council, will produce stenomorphs of the various species.

Paul Bartsch

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[1] Science. Vol. LV, No. 1414, p. 131, February 3, 1922.

BOTANICAL LITERATURE FOR RUSSIA

THE world's war and the following events tore Russia away from the civilized world and stopped any access to its scientific literature. Now that normal relations between our country and its neighbors are being partly restored and the scientific literature of Western Europe begins little by little to penetrate into Russia, we are still deprived of North American publications. At the same time the financial conditions of our country are such that we are unable to purchase them from booksellers. This leads me in the name of the laboratory under my supervision to address botanists of the United States and to ask for help in our scientific work by sending copies of recent papers, books, etc. We shall be glad to send in return our publications.

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SCIENTIFIC BOOKS

The Biology of Death. By RAYMOND PEARL. Philadelphia: Lippincott, 1922.

In many fields of scientific research, where progress is most active, the old barriers which have so long separated men of like mind and partitioned off congruous subjects are now disappearing. This fact is widely recognized in the case of physical chemistry, of general physiology, and of atomic physics. But there could be no better illustration of it than the new monograph on experimental biology, "The Biology of Death." Professor Pearl, an experimental biologist, has not found it necessary to change either his point of view or his methods of research in taking up his duties as professor of vital statistics, and in his first book dealing with the subject of his new chair he has drawn upon a wide variety of sciences, including cytology, pathology, genetics and statistics, without sacrifice of unity and with the happiest results.

The book opens with two questions: "Why do living things die?" "Why do living things die *when* they do." Pearl's answer to the first question may perhaps be stated as follows: Single cells, whether unicellular organisms, germ cells or somatic cells, die only by chance. All cells are potentially immortal. The proof of this statement is to be found in the work of Woodruff on *Paramecium,* of Jacques Loeb on artificial parthenogenesis and especially of Harrison, Leo Loeb and Carrel on tissue culture. Normal death in the metazoa is due to the wearing out of units of a higher order than cells, it is a result of the specialization of structure and function of the highly differentiated multicellular being.

It seems to me that this is probably a sound inference. Nothing could be plainer than the fact that death from valvular disease of the heart, or from cirrhosis of the liver, or perhaps from diabetes, corresponds with Pearl's statement. The conception also has the advantage of being analogous to our ordinary view of the wearing out of useful objects. Thus we wear out our boots or their soles, but the molecules of which they are composed remain unchanged. Indeed an aggregate of aggregates must be more unstable, in certain respects, than its component aggregates, for its existence depends upon the integrity of each component and of the relations between them. But it must be confessed that, until certain phenomena of senescence such as desiccation and the more conspicuous intracellular changes can be clearly accounted for, doubt will remain regarding the complete validity of any statement concerning this question, simply because we shall continue to feel uncertain of the exhaustiveness of our analysis.

In answering the second question Pearl turns to his own researches and classifies the causes of death "under the heads of the several organ systems of the body, the functional breakdown of which is the immediate or predominant cause of the cessation of life." A statistical treatment of the data, founded upon this classification, leads to the conclusion that the causes of death operate in a very orderly and regular manner, the biological significance of the regularities being, as a rule, not difficult to understand. Thus, in the first year of life the alimentary tract is to be charged with the greatest number of deaths, for the next fifty years of life it is the respiratory apparatus which takes first place, in old age the circulatory system.

From these facts the conclusion is drawn that advancement of the physiology, pathology and hygiene of the respiratory organs should take a very high position in our effort to promote the health of the community and to lengthen human life.

Another and more compact biological classification of the causes of death depends upon the discrimination of the germ-layers from which the different organs arise. This yields the result that parts of endodermal origin are the most vulnerable (fifty-seven per cent.), those of ectodermal origin the least (about ten per cent.).

This subject is followed by a presentation of the evidence, first from statistics on men, then from Pearl's own interesting experimental studies of *Drosophila,* that length of life is inherited in a normal manner. Especially after an examination of these experimental data it is impossible to escape the conclusion that, other things being equal, duration of life follows the Mendelian laws, or the impression that further information and perhaps novel discoveries must result from the study of so unique a character.

But how far does environment modify the hereditary length of life in man? What is the accidental, what the preventable shortening of human life? To the analysis of this question much space is devoted. First comes the evidence that the expectation of life at birth in civilized communities has been increasing over a period of two thousand years. No doubt as a result of this fact, the expectation of life at advanced ages has meanwhile been growing less. It is difficult to see how these facts can be fully reconciled with another statement arising later from experimental evidence "that environmental circumstances [probably] play their part in determining the duration of life, largely, if not in principle entirely, by influencing the *rate* at which the vital patrimony is spent."

So far as the prospects of further great increases in the length of life are concerned, it is not surprising to find Pearl a moderate sceptic. Like yellow fever in the past, other diseases will no doubt be conquered by scientific methods in the future. Still others will be more and more restricted. But, on the other hand, it seems clear, according to Pearl, that some effects of preventive medicine are much over-estimated, partly through our ignorance of epidemiology, partly because of the sentimental enthusiasm of ignorant optimists. On the other hand, "the inherited length of life" definitely limits the progress that can be made through the agency of applied science. At this point the doubtful question seems to be how much progress can still be made before diminishing returns check further increase of effort. Pearl's opinion seems to be that long before the expectation of life at birth in the United States has been lengthened by thirteen years (a fair estimate of the effect of elimination of all preventable deaths) the law of diminishing returns must put an end to substantial progress. It is interesting, if only academically, to note that selection of long-lived stock, as in Pearl's *Drosophila* experiments, would rapidly lead to much greater results. These conclusions are reinforced by the fact that the death rate of the earliest period of life, and presumably of all periods, is selective. On the other hand those both of whose parents survive to the age of eighty live twenty years longer than those neither of whose parents reach the age of sixty.

This interesting book closes with the discussion of what is perhaps its most important contribution to the problem of population, the theoretical population curve of Pearl and Reed. This curve, which was developed from a simple hypothesis, has the formula

$$y = \frac{b}{e^{-ax} + c}$$

x being time and y population. It is a curve which also arises from the discussion of other natural phenomena and it fits the facts of population in a large number of independent cases with truly remarkable accuracy. With its help the discussion of the population of the United States leads to the conclusion that the *present* growth of population in this country is approaching a maximum of about 197,000,000 and that, unless some other new phenomena of growth or decay should be added, this maximum will be nearly reached in one hundred years.

A book so full of complex problems vigorously treated can not fail to arouse both interest and opposition. It is safe to say, however, that Professor Pearl has done an important work of scientific synthesis which must encourage and disseminate clear, critical, un-sentimental thinking about one of the greatest of social problems.

L. J. HENDERSON

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SPECIAL ARTICLES

OCCURRENCE OF HUMAN REMAINS WITH PLEISTOCENE FOSSILS, LAGOW SAND PIT, DALLAS, TEXAS

THE closing of the Lagow Sand Pit, Dallas, Texas, is a matter of regret to students of Pleistocene fossils in the southwest. This sand pit has been operated for seventeen years, excavating an area of about five acres. The pit is a part of a large featured terrace which follows the Trinity River for a number of miles. The top of the terrace is about fifty feet above the flood plain of the stream. The number of fossil finds has been large, though few of the finds have been saved. Of the fossils now preserved in the museum at Southern Methodist University, Dr. R. S. Lull has described seven species, with two new species and one new genus. Included in the list are a sabre-tooth tiger, deer, four-horned antelope, bison, camels, horse and mammoths. Since the closing of the pit makes it impossible that further knowledge will be gained from the locality, it seems a proper time to put on record the finding of a human skeleton associated with the Pleistocene fossils of the pit.

Section of Lagow Sand Pit

Top soil. Medium grained sandy loam, dark red to black	2 ft.
Sandy clay, hard, tenacious. Red	3 ft.
Fine sandy clay with light calcareous segregations and streaks. Texture of sand varies. Color yellow. *Fossils:* Antelope, bison, mammoth, man	2 ft., 10 in.
Fine to coarse clean white sand and gravel. Gravel usually under one inch. Cross-bedded. Forest beds not over 12 to 14 inches, usually 3 to 4 inches. *Fossils* usually found at bottom, especially larger bones. Bones clean and usually white or cream in color. Mammoth, camel	14 ft.

On October 26, 1920, I was notified by the owner of the pit that the workmen had uncovered bones which seemed to be human. Taking with me Dr. Robert T. Hill, I visited the pit, but found that the bones had been removed from the sand.

Referring to the above section, it is noted that only the lower part of the pit, the cross-bedded white sands, are commercially valuable. The upper layers constitute an over-burden. The over-burden is removed first. All of the workmen were agreed as to the location of the find—about five feet below the surface of the soil. There was no evidence along the wall of any disturbance or mixture of the different beds from bottom to top. Dr. Hill and I made close examination on this point. Mr. Lagow pointed out that there was no evidence of a grave having been dug, when it was suggested by a bystander that the man had been recently buried. The layers above the bones were well-marked stiff clays, and would apparently have shown any change or mixture with the beds below, such as would have been the case in digging a grave.

An examination of the sand and dirt found on the bones confirmed the statements of the pit men as to the exact position of the find. Mr. W. E. Wrather and Professor J. D. Boon, geologists, also visited the pit on the following day, likewise agreeing that there was no evidence of disturbance in the layers above the position of the human bones.

Only the one skeleton was found in the pit. No human implements or artifacts have been recovered. Dr. George Grant MacCurdy made the following report on the specimens:

> The human bones from Dallas comprise segments of right and left femur, right and left tibia and right fibula; also the left horizontal ramus of the lower jaw and several fragments of the calotte. All presumably belong to one individual, a large adult male of the modern type. This is about all one could say without having in hand more of the skeleton.

A chemical analysis of the fossilized bones from the human skull and from the camel skull made by Miss May Whidsit, of Southern Methodist University, gives the following results:

Human:	
P_2O_5	30%
CaO	57.8% 32.3%
Camel:	
P_2O_5	31.5%
CaO	55.4 % 31.04%

The degree of fossilization of the human skull and that of the camel are approximately the same. Had these human bones been of any other species, no question of association would be raised. All would agree that they were contemporaneous.

In the Lagow Sand Pit it is necessary to lay aside the association of "modern man" with Pleistocene fossils as due to burial by landslide, by recent stream action, by uprooting trees, or by any agency except a human agency. If the remains were buried by human agency, two things appear remarkable: First, that there was no visible evidence of the grave having been dug, although the skeleton was found in a sand layer beneath two beds of clay; second, that while the deposits of fossils in certain areas of the pit were much richer than others, and occupy limited areas in the pit, the location of the supposed grave was, *mirabile dictu*, placed exactly in such a limited fossiliferous area as would have occurred if laid down contemporaneously with the other fossils.

An account of this occurrence was withheld from print in the hope that further material would be found. At least a dozen occurrences in North America report human remains or artifacts associated with Pleistocene fossils or Pleistocene deposits. A review of these cases shows that in applying the theory of the multiple hypothesis, the most elaborate and involved explanation is always chosen rather than the simple direct fact of visible association and contemporaneity. Should a visible association be of less importance than a preconceived notion as to the type of man which ought to be uncovered with Pleistocene fossils?

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THE EFFECT OF SODIUM HYPOCHLORITE UPON THE SPORES OF AMERICAN FOUL BROOD (BACILLUS LARVAE)

During the past year we have conducted a number of experiments with various preparations of sodium hypochlorite to determine whether or not this chemical has any value in destroying the spores of *Bacillus larvæ*.

Three lines of experiments were used:

(1) To determine if diluted solutions in sugar syrup fed to the bees would have any effect on control of the disease in a working colony.

(2) To determine if combs containing dead larvæ or dry extracting combs from diseased colonies might be treated and used again without carrying the infection.

(3) To determine if infected honey might be treated so that it could be fed back to the bees without danger of carrying the infection.

(4) To determine if sodium hypochlorite might be used as a disinfectant for hives, hive parts, extractors and other equipment.

The results of these experiments show that sodium hypochlorite has a solvent action on dead bees, pollen, cocoons and other debris in the combs but that it does not injure the wax, and while certain concentrated solutions will dissolve a dead bee in a short time, diluted they are not at all harmful to the bees when added to their food.

Larvæ dead from foul brood and living in the cells as scales were completely dissolved out in twenty-four hours. Four of these combs placed in colonies of bees in June remained free of disease throughout the summer, although the bees continued to rear brood in them.

Sugar syrup to which a water solution of spores had been added failed to carry the disease when treated with a 1 to 25 dilution of a 3 per cent. solution of sodium hypochlorite.

In an experiment where three colonies of bees were fed a diluted solution of diseased honey treated with sodium hypochlorite, two of the colonies had not showed any signs of disease six weeks after feeding; the third colony developed the disease but there is evidence to show that the disease may have come from an outside source.

For disinfecting hive bodies and equipment a special solution was found to be a hundred per cent. efficient.

Experiments in feeding to counteract the disease in colonies already infected were unsuccessful.

The particular value of a special hypochlorite finally decided upon is that it destroys the spores wherever it comes in contact with them but is not poisonous and may be fed in syrup or honey to the bees without apparent injury to them.

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SOME CHEMICAL BEARINGS OF PHARMACOLOGY[1]

Probably the best definition of pharmacology is that which describes it as the study of the action of chemical substances upon living things. Pharmacological problems, therefore, fall into three groups, namely, those which relate (1) to the chemical substances (usually drugs or poisons), (2) to the living things (which may be anything from simple cells to highly complex organisms), and (3) to the reaction between the one and the other. Evidently then a pharmacological problem without a chemical bearing must indeed be superficial.

With regard to the problems of the first group—those relating solely to the chemistry of pharmacological agents—I will call your attention to a chemical classification of drugs which appears to differ from any which have previously been suggested. It should be of interest to every chemist desiring to advance our knowledge of drugs. In the following classes are included only substances whose value in the treatment of disease is at present above question, or likely to be soon established. Suggestiveness rather than completeness is the intent of this presentation.

A CLASSIFICATION OF PHARMACOLOGICAL AGENTS ACCORDING TO THE STATE OF PRESENT KNOWLEDGE OF THEIR CHEMISTRY

1. Substances from which no pure chemical principle has as yet been isolated:
    - Pituitary
    - Insulin
    - Secretin
    - Anti-venoms
    - Anti-toxins
2. Substances which contain definitely isolated chemical principles, but which are employed by preference in impure forms empirically found more effective:
    - Digitalis
        - (Digitoxin

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[1] An address before the McGill Chemical Society, December 8, 1922.

      Digitalin
      Digitalein
      Digitsaponin)
   Vegetable purgatives
      Emodin
      Chrysophanic acid
      Resins

3. Definite chemical entities the details of the structure of which are incompletely known:
   - Morphine
   - Quinine
   - Strychnine
   - Eserine
   - Thyroxin
4. Substances of definitely known structural formula:
   - Simpler compounds
     - Inorganic
     - Organic
   - Natural alkaloids
     - Animal
     - Vegetable
   - Synthetics
     - Barbitone
     - Novocaine
     - Salicylates
     - Atophan
     - Phenacetine
     - Chloramines
     - Acriflavine
     - Atoxyl
     - Salvarsan
     - "Bayer 205"

In every one of these groups the synthetic chemist should find attractive problems. In the first three these relate evidently to the promotion of the substances to a higher category, especially the fourth. But once a drug has attained the final group the chances are still overwhelmingly against being ideally suited to its purpose, and so the synthetic chemist must consider converting it into something a little different but more perfect. This means cooperation between chemistry and pharmacology.

To better illustrate the nature of the problems involved a number of substances from each of the four classes may be discussed. The first category includes three of animal origin. They are known as "endocrine" substances or "internal secretions" because they are elaborated by some organ of the body, and poured directly into the blood stream. Excess or deficit of endocrine principles means disease. In the latter instance the supply may often be satisfactorily maintained by administration of the required active principle.

The first drug which I have noted is the secretion of a part of the pituitary gland (attached to the center of the lower surface of the brain) which has the power of causing contractions in the muscular walls of many so-called involuntary organs. It is used particularly in obstetrical work for its effect in stimulating contractions of the uterus. A well-known chemical substance exhibiting similar pharmacological characters is histamine, but Abel has recently prepared an extract of the pituitary exhibiting twenty times the strength of histamine.

Insulin is the term applied by Banting, Best and Macleod, of Toronto, to their new pancreatic extract which is unquestionably able to lower the blood sugar content of both normal and diabetic organisms, regardless of how high a place it may ultimately take among the remedies for diabetes. The chemist who first succeeds in identifying the active substance in this preparation will have made a contribution of great value to pharmacology.

Secretin is an extract of the duodenal mucosa which, as Bayliss and Starling show, is normally absorbed into the blood stream and carried to the pancreas, where it stimulates the digestive function of that organ.

Antivenoms and antitoxins present difficulties to the chemist on account of the comparatively small quantities available. Profound effects in the body result from the introduction of solutions which contain but fractions of a milligram of pure principle.

Of the second class of drugs—those yielding unsatisfactory chemical principles, the most important members are the digitalis bodies and some of the vegetable purgatives. Of the former the alcohol-soluble crystalline *digitoxin* exhibits the required therapeutic properties, that is to say strengthening and regularizing the action of the diseased heart, but in its pure form presents undesirable side actions, so that the Galenical preparations, which are of course impure mixtures, are found much more efficient in safe doses.

From the vegetable purgatives such as cascara and rhubarb have been isolated *emodin* and chrysophanic acid—derivatives of anthraquinone. Other vegetable purgatives contain definite resinous principles, but here again the crude drugs are preferred, as they delay absorption of these purgative principles from the bowel into the blood stream, and thus prolong their action in the former region where it is desired.

In the third class have lingered for about one hundred years a number of the most important alkaloids. The chemical isolation of these early in the nineteenth century is associated particularly with the names of Pelletier and Sertuerner.

Morphine, quinine, strychnine, eserine and others still defy the structural chemists; witness, for example, the conflicting views of Knorr and Pschorr concerning the first of these alkaloids.

Thyroxin is the second of the endocrine principles to have been isolated chemically; this was brilliantly accomplished in recent years by Kendall. The assigned structural formula has however not yet been substantiated, but the drug appears to be a trihydro, tri-iodo derivative of indol propionic acid. It has a content of about sixty-five per cent. iodine, which element has long been recognized as essential to the action of the thyroid principle, although of itself unavailing. Crude thyroid extract has for thirty years occupied a most prominent place in therapeutics. Its constant use keeps in a normal condition those who are unfortunate enough to exhibit a deficiency in the function of this gland.

The large fourth class contains, of course, all the simpler inorganic and organic drugs. Acids, bases and even elements are used in therapy, as well as ether, chloroform, phenol and numerous other organic chemicals. It is surprising how many of these present new chemical problems for the pharmacologist. Attempts, for example, have been made to prove that certain of the metals should preferably be introduced in the colloidal state. At the present time one hears reports of the possibility of colloidal lead as a cancer cure. Again, pure ether has been called into question in recent years. The so-called "Cotton process" ether has been widely advertised as containing impurities to which the anesthetic effects are really due. Chemically pure ethoxy-ethane, however, has been vindicated within the last year by Drs. Stehle and Bourne both clinically and in our laboratory.

SYNTHETIC DRUGS

The natural alkaloids.—Many of the natural alkaloids can now be imitated synthetically, for example, atropine and cocaine, and among the animal alkaloids, the first endocrine drug to be isolated, adrenaline or epinephrine, a powerful circulatory stimulant and hemostatic. Improvements over the first two alkaloids named are seen in the synthetics homatropine and procaine (novocaine) respectively. Procaine in turn is being replaced for some anesthetic purposes by Hirschfelder's saligenin, an instance of an old chemical adapted to a new use.

Countless other synthetic drugs have been developed. Among the most useful of these are barbitone of the hypnotics, acetyl salicylic-acid (aspirin) of the anti-rheumatics, atophan and phenacetine which resemble aspirin in so far as they possess antipyretic and analgesic properties. Such antiseptics as the chloramines and flavines and such agents as atoxyl and salvarsan suggest most interesting chapters in so-called chemotherapy.[2]

Among the newest of synthetics is "Bayer 205" now widely quoted as having been described in Hamburg as the "key to colonial possessions." Its significance lies in its curative value in tropical "sleeping sickness," in which it is said to exhibit the unusual therapeutic ratio of curative dose to toxic dose of 1 to 60.

The chemistry of pharmacological agents concerns itself further with their fate in the body. Nature's laboratory can transform them in many ways. Oxidations, reductions, decompositions and syntheses of drugs all occur, and the resulting products exhibit sometimes less and sometimes more pharmacological activity than the original substance. Thus the conversion to something else in the body may be essential to bring out the real action of a drug, or the result of the change may be to detoxify, as for example, when an excess of morphine is oxidized in the body.

The second of the three suggested fields of pharmacology embraces the living things upon which the drugs and poisons act. The behavior of living organisms considered apart from drugs pertains especially to the realms of physiology and pathology. The chemical viewpoint is continually assuming larger proportions in these fields, and the pharmacologist is continually concerned with their problems.

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[2] By usage the term "chemotherapy" is generally restricted to the employment of specific etiotropic agents.

PHARMACOLOGICAL REACTIONS

Let us pass, however, to our third division which constitutes pharmacology in its restricted sense, and discuss the reactions between chemical agents and living things. *What* are these pharmacological reactions, and *why* do they occur?

To answer the first question one measures the various manifestations of drug action by either chemical, physical or psychological methods. By chemical methods we may determine changes in the carbon dioxide output of the lungs, in the alkali reserve of the blood, or detect the presence of abnormal constituents in the urine, such as sugar or albumen; any of these things may be influenced by drugs. Examples of physical manifestations are seen in changes in the blood pressure, the pulse rate, the size of the pupil, the temperature of the body, and many others. More difficult of exact measurement are those pharmacological actions which are only subjectively appreciated. The psychical effects of caffein, for example, must be tested by the study of the abilities of perception, association, etc. Still more difficult is it to measure the relief of pain, and to decide in which cases this is really due to the action of the drug.

Although to demonstrate the existence of many pharmacological reactions we do not always need to invoke the aid of chemistry, this does become necessary when one approaches the more fundamental question of *why*. The rate and output of the heart are, for example, measured in physical units, but their ultimate basis is chemical or physico-chemical, as are the reactions between drug and cell which may alter them. In the study of these reactions comparatively little progress has been made. One fact, however, concerning changes in function produced by drugs appears to be certain, —they are never qualitative. While we may increase or decrease a cell's normal activity we can not alter its nature. By, however, stimulating certain functions, depressing others coincidently, and leaving still others untouched, drugs and poisons can elicit an endless variety of responses, as seen, for example, in the different types of behavior produced by various convulsants or by narcotics.

In seeking to determine why certain effects are produced by chemical substances, cells and tissues may be removed from the body and investigated while thus isolated, but such methods lead to wrong inferences as to the nature of the reaction *in vivo* unless many of the changed conditions are taken into consideration. Not the least important factor is the rôle of the medium in which the pharmacological agent is dissolved. What happens in an aqueous solution may be very different from the result in the presence of a complex of colloids, salts, etc., such as the blood. One of the chief foundations of pharmacology, therefore, is the chemistry of the blood.

Among the factors concerned in the reaction between drug and cell must be considered changes in osmotic conditions, surface tension, cell permeability, absorption, hydrogen-ion concentration and the like. The mechanism of narcotic action is partially elucidated in many cases by reference to the interesting parallelism between the lipoid-solubility and narcotic effects of a series of anesthetic drugs. But because the cells of the nervous system owing to their lipoid content exhibit an affinity for such drugs, does not tell us why the satisfaction of this affinity should necessarily alter their function. One may conceive of the molecule of chloroform, for instance, binding itself to certain constituents of the cell which normally function by a continual give and take of other substances. When this occurs function would become depressed or cease; but direct evidence in support of this and similar explanations is lacking.

As another example of pharmacological analysis, take the effects of certain poisons upon the heart. Straub has shown that while one of these will act only when a certain amount has penetrated into the interior of the cell, another merely requires contact with the cell surface. The latter appears to enter into no sort of reaction, for it can be recovered practically quantitatively from the fluid leaving the heart. A third poison exhibits its action only while passing in or out of the cell, that is to say, during the period in which chemical equilibrium is being established between the cell and the medium which surrounds it. Again we are at a loss for definite knowledge of the nature of the reaction between drug and cell.

A few cases seem simpler and are perhaps better understood, among which may be mentioned the combination of pharmacological agents with the hemoglobin of the red blood cell. Ordinarily the hemoglobin carries oxygen in loose combination. When a toxic substance, for example, carbon monoxide, which has a greater affinity for hemoglobin, enters the blood, there is formed the firmer combination known as carbon monoxide-hemoglobin. Oxygen transportation is thus interfered with to an extent which may or may not be compatible with the continuation of life. This will depend upon the percentage of carbon monoxide in the inspired air, and the consequent concentration in the blood. The minimal lethal concentration is, of course, less in rarefied atmospheres where there is less oxygen with which the poisonous gas has to compete.

ANTIPYRETIC DRUGS

The variety in the nature of the chemical bearings of pharmacology may be illustrated further by examples from a single field, that of the action of antipyretic drugs. The term "antipyretic action" was introduced to describe the reduction of fever temperature, but drugs having this capacity, of which we have mentioned the salicylates, atophan and phenacetine, all exhibit to a greater or less extent the property of relieving pain. This analgesic action constitutes their widest field of usefulness today.

To the need of improvement upon most, if not all, of our present synthetics reference has already been made. Among the antipyretics salicylates and atophan in their use in rheumatic fever require doses which sometimes approach the point of toxicity. The ethyl ester of methyl atophan, known as tolysin, appears to remove this objection, for we have found that it is far less toxic. Dr. Lozinsky and I have shown in experiments on dogs as well as in human rheumatic fever that the reason for the comparative safety of this drug is its slow rate of absorption from the intestine. Given over a considerable period of time it is just as efficient as salicylates, and is completely absorbed in therapeutic doses, but when larger amounts are introduced the excess above the therapeutic dose can be largely recovered chemically in the excreta, never having been absorbed by the body at all. This coincidence of therapeutic dosage with the limits of intestinal absorption is a fortunate peculiarity in pharmacological action.

The structure of tolysin is based on the so-called salol principle, the esterification protecting the stomach from the irritating action of carboxylic acid. The dog's stomach is unharmed by doses the aspirin equivalent of which produces serious erosion and ulceration.

FEVER

The mechanism of antipyretic drug action involves a number of problems in our second group. The behavior of living things includes an understanding of the physiology of temperature regulation and the pathology of fever. What are the chemical and other differences between the fevered and the normal organism?

In fever there is an increase in the production of bodily heat; this is paralleled by an increase in the oxidations which, in fact, are usually taken as a measure of the heat production in the body. Increased heat production is not, however, the cause of fever, for far greater increases fail to raise the temperature of a healthy subject. DuBois has recently shown in a variety of clinical fevers that the increase of bodily oxidations corresponds quantitatively to Van't Hoff's law that the velocity of chemical processes increases from two to three times for every 10°C. increase in temperature. The poisons which produce human fevers, whether of bacteriological origin or chemically known substances such as cocaine, do not then accomplish this by increasing the production of heat, but rather by interfering with the mechanism by which heat is eliminated from the body.

This heat-dissipating mechanism has hitherto been considered to depend chiefly upon the shifting of blood from the protected regions of the body to the surface. But in the reaction against a hot environment the blood becomes not merely shifted but diluted, thus affording both a larger surface flow for radiation and more "free" water for evaporation from the lungs and for sweating.

Now in the production of fever these heat-dissipating processes become disturbed, and we are all familiar with the blanching of the skin due to peripheral vaso-constriction, and the chilly feeling which accompanies a sharp rise in body temperature. These indications of a poor surface flow are associated with a loss of water from the blood, as I have shown particularly in the case of "coli fever" with Dr. Howard, and of cocaine fever with Dr. Moise. The loss of water from the blood may be variously measured, for instance by colorimetric determination of the hemoglobin content, by red blood cell counts, or by weighing blood samples before and after drying to determine the total solids. Certain poorly diffusible dyes may also be injected for the purpose of measuring changes in the water content of the blood. Among other accompaniments of water loss is noted increased blood viscosity.

A further change in the chemistry of the blood in experimental fever has recently been noted by Sansum, who found that the alkali reserve or titration alkalinity of the blood becomes diminished as the temperature rises. One is therefore bound to speculate upon the possibility of water shifting being influenced by the formation of acids in the tissues in connection with the "chill" phenomenon. This and questions relating to the permeability of the cells, and to the rôle of other physical or chemical changes produced by fever poisons afford an untilled field for investigation.

MECHANISM OF ANTIPYRETIC ACTION

To return to the action of antipyretic drugs in fever—this has been investigated both from the point of view of the effects of these drugs upon heat production, and upon heat dissipation. In numerous tests upon fever patients I have found that drug antipyresis is accompanied by only a slight decrease in heat production. The decrease corresponds to the demands of Van't Hoff's law and seems therefore an effect rather than a cause of the temperature fall. Diminished heat production does not then suffice to account for the phenomenon.

Elimination of heat on the other hand was found greatly increased, for example, in the case of aspirin antipyresis. In my experiments the elimination of heat was increased by nearly 40 per cent., its production reduced by less than 4 per cent. The process of dissipation, therefore, is the one which is most affected, and this mechanism is approached, as said, through studies of the circulation.

Nearly every one has witnessed the reddening of the skin and sweating which is associated with antipyretic action, and in this connection Dr. Herrmann and I first showed that antipyretic drugs dilute the blood of the fevered animal coincidently with the reduction in temperature. Evidence of the importance of this increase in the water content of the blood is found in the fact that in healthy subjects equivalent doses of antipyretics will neither reduce the temperature nor dilute the blood.

Having observed some increase in the dextrose content of the blood as a result of antipyretic drug action, and having noted also that dextrose itself may reduce the body temperature, we were led to consider an increase in the osmotic pressure of the blood as possibly responsible for the accumulation of water. This argument was pursued by the injection of dextrose intravenously in normal and in fevered animals. It was found that under the same conditions in which dextrose produced a slight dilution of the blood and no fall in temperature of the normal animal, a marked antipyretic action with rapid and extensive dilution of the blood was seen in the case of fever. Similarly, intravenous injections of acacia were found to reduce the temperature of fevered rabbits and dogs. The question of antipyretic drug action therefore resolves itself into a problem with many chemical bearings, especially that of water shifting and water metabolism in the body.

Before leaving the antipyretic drugs attention may be called to studies which Dr. D. S. Lewis and I made of the mechanism of their analgesic action. Coincident with the relief of headache we have found again a dilution of the blood, which, as stated above, does not occur in normal individuals. Since Cushing, Weed and others have shown that so-called pressure headaches may be relieved by use of concentrated salt solutions, either by mouth or intravenously, apparently withdrawing fluid from the brain in this way, one is led to expect that antipyretic drugs may act in a similar manner.

Sufficient has been said to indicate how superficial our knowledge of drug action still is, and in how many directions the aid of chemistry must be invoked.

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THE PRESENT SITUATION IN THE RADIUM INDUSTRY[1]

DISCOVERY OF RADIUM

THE discovery of X-ray in 1895 by Roentgen paved the way for the discovery of radioactivity which occurred about a year later. Becquerel, stimulated by the observations of Roentgen, investigated the field of phosphorescent light and found that phosphorescent uranium compounds emitted a type of radiation similar to X-ray in that it traversed material bodies.

This property of uranium salts was later found to be due to the disintegration of the uranium atom and not to phosphorescent light, and this eventually led to the discovery of the entire uranium series consisting of fifteen radioactive elements.

UNITED STATES THE PRINCIPAL PRODUCER IN THE PAST

Although radium has been found in many countries of the world, including Bohemia, Portugal, Australia and England, the United States has been the principal producer.

It has been estimated that 150 grams of radium, costing approximately $20,000,000, have gone into consumption to date in the United States, of which 90 per cent. has come from the carnotite ores of southwestern Colorado and southeastern Utah, which clearly shows the commanding position the American industry has enjoyed. This industry is naturally exceedingly young, not having existed more than fifteen years. During this time about ten domestic companies have engaged in the production and sale of radium. Last year five companies were still operating.

In spite of the youth of the industry, approximately $10,000,000 have been expended by American companies, this capital being entirely represented by mines and plants.

PROBLEMS OF AMERICAN PRODUCER

American carnotite ore is low grade, running about 2 per cent. uranium oxide content. The deposits, although extensive, are spotty and must be prospected by means of the diamond drill. It is true that the ore occurs near the surface, but after it is mined it has to be hand-sorted, put in canvas bags, packed several miles by mules to a motor truck line, hauled by motor truck to a narrow gauge railroad line, transferred from narrow to standard gauge and transported to Denver. The cost per ton varies between $40 to $70 depending on the location of the ore and on 2 per cent. ore; this means that 98 per cent. of these high freight rates is paid on sandstone.

As ore bodies are widely scattered, and as one pound of acid is required to treat each pound of ore, it would not be profitable either to treat the ore at the mines or to put up a mill for water concentration.

Besides the physical difficulties of prospecting and of transporting the ore to the plant, exceedingly complicated chemical problems are met with in the treatment of the ore, 200 to 400 tons having to be treated to produce one gram of radium. This can be understood when it is remembered that radium is a disintegration product of uranium, there being only one part of radium to 3,200,000 parts of uranium in any ore.

Never a year went by but rumors were circulated of the discovery of rich deposits of radium-bearing ore which would put the American producer out of business and these rumors had to be carefully investigated at heavy expense.

RADIUM IN THE BELGIAN CONGO

Strange to say, during all this time deposits of radium bearing ores, many times as rich as the American carnotite ore, existed in the Belgian Congo.

These ores were discovered in 1913 near Elizabethville in the province of Katanga, in the course of prospecting work which was being done on the Luiswishi copper owned by the Union Miniere de Haut Katanga, a powerful Belgian corporation.

Shortly after the discovery and before any commercial operation of the deposits could be attempted, the war broke out and the Union

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[1] A paper given before a joint meeting of the American Chemical Society, the American Electrochemical Society and the Société de Chimie Industrielle, New York Sections, February 9, 1923.

Miniere found its technical and commercial staff depleted. In addition, it was forced to increase its output of copper to 40,000 tons per year for use by the allied countries and these conditions temporarily prohibited the exploration and development of the radium properties.

It must also be remembered that the outcome of the war could not be accurately predicted; hence the Belgians endeavored to keep their discoveries secret, thinking that should the war be lost they might still control the output of radium.

After the war, the company recruited its staff and commenced development. The policy of secrecy was still maintained, however, and no announcement was published until the largest plant in the world for treatment of radium ore had been completed at Oolen, Belgium, and the Belgian company was in readiness to start production.

RESULT OF BELGIAN COMPETITION

The announcement of the Belgians was received by American producers with considerable concern; hence when the Belgians invited two of the large American companies to confer, they were quick to send their representatives to Belgium.

It was immediately recognized that the African deposits must be of considerable size to warrant the erection of the Oolen plant, in spite of the fact that this plant could be used for other purposes than the treatment of radium ores.

While it is true that the Belgians must transport their ore 2,000 miles down the Congo River, across the ocean to Antwerp and thence by rail to Oolen, this procedure is much more economical than endeavoring to treat the ore in the heart of Africa, and notwithstanding this long haul, Belgian radium can undersell the American product by a large margin.

The conference between the representatives of the American companies and the Belgians resulted in The Radium Company of Colorado forming a joint selling organization with the Belgians, and the new company will market radium throughout the world.

With the appearance on the market of the Belgian product, the American mines shut down and the price of radium dropped to $70 per milligram, the lowest price on record.

The question of a tariff to protect the American radium industry naturally occurred to the American producers and although the difficulty of obtaining protection was realized, the moral issue at stake was really the factor which decided against action in this connection. The world needs radium to combat cancer and it was recognized that the lower the price the more widespread would be the use of this valuable agent.

RADIUM PRESENTS DIFFICULT SALES PROBLEMS

The sale of radium is a most complicated problem. Radium therapy is a new science and the first essential is to bring home to the doctor the value of radium in the treatment of various conditions and for this purpose medical departments are maintained. These departments publish periodicals containing the latest articles on the therapeutic use of radium and act in a general consulting capacity to doctors using or contemplating the use of radium.

Once the doctor is convinced of the value of radium, the work is but half done. Radium is a dangerous agent and must be handled with great care. Hence the American companies were obliged to dot the country with postgraduate schools qualified to give adequate instruction to the purchasers.

Again there is the question of instruments for the therapeutic application of radium and the companies have had to maintain elaborate medical research departments to devise and manufacture the most efficient accessories possible. No doubt these departments do some of the most precise work being done to-day, although the volume of their output is comparatively limited.

Besides these special departments, the commercial companies have had to maintain elaborate chemical and physical departments and hence the Belgians have gained a large advantage by being able to draw on the accumulated technical and sales knowledge of their American associate. The net result of the consolidation will undoubtedly result in as cheap and probably cheaper radium than had the consolidation not taken place.

METHODS OF MANUFACTURE AND PRECAUTIONS REQUIRED

Just a brief sketch of the methods of producing radium from the American carnotite ore and precautions required may be of interest.

The ore is crushed, the radium leached out and the solution treated with sulphuric acid to precipitate the insoluble radium barium sulphate. This precipitate is changed into the soluble carbonate and this resulting solution is converted into the bromide and that in turn into the chloride. Radium always occurs with barium and a physical property of the radium chloride is used to separate it from barium chloride as the former is less soluble in saturated solution than the latter. About 2,200 separate crystallizations are required to produce radium chloride of 95 per cent. purity.

Large fans are in constant operation over the vats containing the radium liquors. These serve to drive off the gaseous emanation and prevent it from breaking down and depositing in the immediate vicinity as radium a, b and c which are solids and which give off destructive rays.

There is no particular danger in handling radium sulphate freshly precipitated, as it does not start disintegrating to any appreciable extent for three or four days after precipitation. Therefore preparations of these salts can be made up with comparative safety.

Continued handling of radium preparations lowers the blood count and produces a general anemic condition. Because of this fact, the United States Bureau of Standards and the commercial companies take the blood count of their employees regularly. If the employee's health has become impaired, he is given a vacation, away from radium, to enable him to recuperate.

COMMERCIAL USES OF RADIUM

You will have gathered from some of the previous statements that one of the chief uses of radium is in the medical profession.

It was early discovered that radium broke down successively into radium emanation, radium a, radium b, radium c and radium d, gaining equilibrium with these decay products in approximately 30 days. During this process of disintegration, three rays are given off—alpha, beta and gamma. The first has little penetrating power and is stopped by a sheet of paper. The second is more penetrating, while some of the third will penetrate ten inches of steel. Shortly after the discovery of radium it was found that the last two rays were destructive to certain kinds of cells and the medical use of radium in the treatment of various conditions is built around this susceptibility of the cell to the action of radium rays.

Many different conditions are treated by radium, including cancers and tumors, although radium is also used in much less serious conditions; for example, the removal of birthmarks, warts and tonsils.

At present extensive work is being done on cancer. Except in very advanced cases, this disease can be arrested, but the big problem is to prevent its recurrence. In case it does not recur in ten years, it can be considered to have been cured. Ten years, however, is a very long time for experimental purposes, and interesting experiments are now being carried on with mice and flies. If the disease does not recur in ten weeks in the case of mice, it has been eradicated, while in the case of flies, the time can be measured in days. Hence these experiments will shortly give knowledge which would require an exceedingly long time to acquire by the treatment of human beings.

Two general methods are being followed today in the use of radium in medicine. The first is the use of radium sulphate put up in needles, tubes and plaques. The needles most widely used are the 10 milligram non-corrosive steel needle having a diameter of 1.5 millimeters and a length of 29 millimeters (about the width of a pin head and a trifle longer than the ordinary pin), and the 5 milligram needle having the same diameter with half the length. The barrel of these needles is bored out to provide a radium chamber into which the radium is inserted. Asbestos packing is then placed next to the radium, the eye is inserted and then soldered into place.

In the treatment of disease these needles are buried directly in the affected tissue and left until the required radiation has been delivered.

The tubes employed are made of glass, filled with radium, sealed, and are usually enclosed in small metal capsules which are placed against the tissue to be treated.

Plaques are flat surface applicators containing a fine layer of radium salt underneath a layer of non-corrosive steel, the latter being usually about one tenth of a millimeter in thickness. This permits a large proportion of the hard beta rays to pass, these rays being beneficial in many skin conditions.

An adequate initial supply of radium for the individual doctor would be about 100 milligrams, costing around $7,500, including applicators which are now furnished without charge with the radium. As radium has a half life period of 1,760 years, this amount would decay to 50 milligrams in that time. Hence for all practical purposes it is everlasting.

Insurance rates on radium in the forms mentioned are relatively high, amounting to about 2½ per cent. per annum. These high rates are due to the chances of loss surrounding the use of the element as above mentioned.

A second method is the use of radium emanation which is the first disintegration product of radium and a gas. This necessitates the use of a solution of some radium salt, preferably the bromide, which is unstable. The radium solution is usually placed in a closed container in a safe with a tube leading to a pumping and collecting apparatus, the gas being pumped off and collected in fine glass capillary tubes. These are sealed off by flame and imbedded in the tissue-like needles except that needles are extracted while the glass spicules are left in. The radioactivity in these spicules loses 16.5 per cent. of its activity the first day, 16 per cent. of the balance the second day, and so on, becoming entirely inactive in 30 days.

The minimum quantity of radium necessary for this technique plus the cost of an emanation apparatus would run at to-day's prices in the neighborhood of $40,000. Insurance charges on the radium in this form are less than on needles, tubes and plaques, being about ½ per cent., but there is the added cost of keeping a trained physicist to collect and measure the emanation. However, this method, supplemented with needles and plaques, would be extensively used were it not for the large initial cost.

One of the properties of the radium rays is that they ionize a gas and this property is used in making measurements by means of the electroscope instead of using the weight measure which would be impractical with such minute quantities. Radium is usually sold on United States Bureau of Standards certificates as to amount of radioactivity present as determined by the electroscope, the radium companies guaranteeing the purity of the radium. Determination by the electroscope is exceedingly accurate and Soddy has stated that if half a grain of radium bromide were divided equally among every human being in the world, one such portion could be detected.

The second largest use of radioactive substances is in the manufacture of luminous material for a variety of uses, such as for watch dials, electric switches, pendants and novelties. Here again the rays emitted by radium are made use of. Zinc sulphide crystals when bombarded by radium rays become luminous and a compound of this substance and a radioactive element is mixed with varnish and applied to the area where the luminosity is desired. The life of these luminous substances is roughly from two to ten years, depending on the quantity of radioactive substance present. Zinc sulphide crystals break down under the constant bombardment, so the greater the luminosity the shorter the life.

The radium companies get out a spinthariscope for display purposes. This is a short metal cylinder about one inch high and half an inch in diameter. In the bottom is placed about one twentieth of a cent's worth of radium mixed with zinc sulphide crystals, and when this is viewed in the dark room through a lens at the top of the cylinder, a myriad of tiny flashes can be seen. Were it not for the destruction of the zinc sulphide crystals these flashes would continue for 2,500 years, which gives an idea of the size of the atom. Rutherford has calculated one gram of radium in equilibrium with its decay products emits 140,000 billion alpha particles per second.

THE FUTURE OF RADIUM

The future of radium in the medical and luminous material field is assured. As to other future uses it would be idle to speculate. Certainly its properties as a catalyzer and ionizer are worth careful investigation. Here is a substance combining infinitesimal bulk with maximum energy. Those who are engaged in the radium industry would not be surprised to see this substance in use in many commercial fields within the next few years. As a matter of fact, its ionizing properties are now being tried out by several companies along commercial lines.

H. E. BISHOP

EASTERN MANAGER,
RADIUM COMPANY OF COLORADO

CHANGES IN LONGEVITY OF AMERICANS IN THE LAST DECADE

EVIDENCE was given by the writer in the issue of SCIENCE of July 7, 1916, in the form of abridged mortality tables to show that the average length of life has been increasing for the whole span of life for both sexes of the registration area of this country, at least ever since the federal government began to compile statistics which could be safely used in the construction of such tables. The same tables showed also, however, that this improvement in longevity was being realized in spite of a deterioration or retrogression at certain advanced ages and that the average length of life corresponding to those advanced ages was less in 1910 than it had been for at least twenty years. The record of the females seemed, however, to be a little more promising than that of the males because the retrogression of that sex was less pronounced in the decade from 1900 to 1910 than from 1890 to 1900 while in the case of the males it was a little more pronounced except that, as also in the case of the females, slight evidence appeared in the last decade of a "come back" at the extremely advanced ages.

The purpose of this paper is to extend the results of the paper just mentioned to include those of 1920. It will be noticed that the record of both sexes shows remarkable changes. Although the explanation of the method[1] of constructing abridged mortality tables and the mortality tables themselves are omitted here it should be said that whereas the populations were necessarily changed slightly during the earlier investigation in order to include the year 1890 this investigation includes only the years 1900, 1910 and 1920. The mortality tables then were constructed from the population and mortality statistics of each of the three years just mentioned for the ten registration states, Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont. Since the tables are constructed from the statistical data of single years and without any process of smoothing it is well to repeat the statement of the earlier paper that no claims are made in regard to the accuracy of the absolute results. Attention is called merely to the *trend* of the death rates and longevity. Moreover, it is obvious that the conclusions of this paper refer particularly to the populations of the states included in the investigation but should apply in a general way to populations of states of the same general geographical area. The abridged list of death rates and corresponding differences are as follows:

DEATH RATES PER 10,000

AGES	1900	DIFF.	1910	DIFF.	1920
		FEMALES			
10	39	— 9	30	— 4	26
20	58	—15	43	+ 3	46
30	83	—20	63	+ 6	69
40	98	—14	84	— 3	81
50	143	—11	132	—10	122
60	262	+ 2	264	—15	249
70	549	+20	569	— 1	568
80	1206	+44	1250	—25	1225
		MALES			
10	39	— 7	32	— 2	30
20	60	—12	48	— 3	45
30	83	—13	70	— 8	62
40	109	— 3	106	—23	83
50	159	+ 8	167	—35	132
60	293	+22	315	—34	281
70	606	+27	633	—29	604
80	1323	+45	1368	—36	1332

There is substantial agreement of the results of this paper and of the earlier paper cited above for the decades covered by both papers although it will be noticed on comparison that the ages considered are different. Thus, the death rates of females decreased for ages 50 and below but increased at the higher ages for the decade 1900 to 1910. In the decade from 1910 to 1920, however, two remarkable results are to be noticed. First, there is a substantial decrease in death rate at that period of advanced ages at which there has always been a retrogression. Second, an unexpected retrogression in the neighborhood of ages 20 to 30 is indicated. The latter is surprising because both males and females have never before in the previous twenty years failed to register a significant reduction in the death rate at all the earlier ages. It is especially surprising that this retrogression should occur among the females when we recall that the females almost always surpass the males in longevity and general health improvement. It is to be hoped that someone can offer an explanation of this retrogression.

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[1] October, 1919, Bulletin of the American Mathematical Society.

The apparent sudden break in the differences in death rates at age 70 for this decade is a little disconcerting and is probably due to inaccuracy in the statistical data. When, however, we consider that the death rates given above are computed practically independent of each other it is more surprising perhaps that more "breaks" are not encountered.

The record of the males is also very unusual. Although the death rates decreased at ages 40 and below and increased at higher ages in the decade from 1900 to 1910, as was found in the earlier investigation, the death rates for the decade from 1910 to 1920 not only decreased at every age but decreased the most by far at the very ages at which there has always been a retrogression before; moreover, the decrease is much greater at those ages than in the case of the females. The improvement is so great at the advanced ages that the writer investigated the mortality statistics of 1919 and found them in substantial agreement. It should be stated parenthetically that since the population statistics are collected but once in a decade the mortality tables could be constructed only for the years considered without the employment of an undesirable scheme of interpolation for the population statistics.

The table of expectations of life is as follows:

EXPECTATIONS OF LIFE

AGES	1900	DIFF.	1910	DIFF.	1920
			FEMALES		
10	50.8	+1.9	52.7	+ .2	52.9
20	43.0	+1.5	44.5	+ .1	44.6
30	35.7	+ .8	36.5	+ .4	36.9
40	28.6	+ .3	28.9	+ .4	29.3
50	21.5	0	21.5	+ .3	21.8
60	15.0	— .2	14.8	+ .1	14.9
70	9.6	— .2	9.4	+ .1	9.5
80	5.6	— .1	5.5	0	5.5
			MALES		
10	49.7	+ .7	50.4	+1.9	52.3
20	41.8	+ .4	42.2	+1.8	44.0
30	34.5	— .1	34.4	+1.7	36.1
40	27.5	— .5	27.0	+1.4	28.4
50	20.6	— .5	20.1	+ .9	21.0
60	14.2	— .3	13.9	+ .4	14.3
70	9.0	— .1	8.9	+ .1	9.0
80	5.2	0	5.2	0	5.2

The values of the expectations of life afford little further information and serve mainly to show the total effect of changes in death rates at certain ages upon the prospect of earlier ages. Thus, although both sexes show an increase in the expectation of life at earlier ages and a decrease at the advanced ages with the females far in the advance as to general improvement in the decade from 1900 to 1910 the order in improvement is completely changed in the decade from 1910 to 1920. The males increase their expectation of life by almost two years at age 10 and since the expectation of life is approximately the same in all mortality tables at the age of birth and age 10 we have here a good estimate in the increase in the whole span of life. The increase in the expectation of life at the successive ages is also very substantial. In the case of the females there is an increase in the expectation of life at all ages but the increase is almost negligible. It is important, however, that there is no period of retrogression at all and it is evident that the increase would have been really significant if it had not been for the unexpected and unusual retrogression in death rates in the neighborhood of ages 20 and 30.

The writer gladly passes on to others the problem of explaining the great improvement at the advanced ages for both males and females or the "set back" at the earlier ages of the females in the last decade. Some claim that an unusually large number of the physically unfit (tubercular, etc.) was eliminated during the period of the war and this might well explain the improvement at the advanced ages. It would be interesting to know how much credit is due to agencies—like the Life Extension Institute, the Y. M. C. A., etc.—which are definitely devoted to the task of improving the health of the mature individual. Some will give much credit to prohibition and there may be considerable justification but it should be recalled in that connection that the last amendment did not go into anything like complete effect until some time after the first of the year (1920) whose mortality statistics form the basis of the results we are just considering.

C. H. Forsyth

Dartmouth College

THE OKLAHOMA-TEXAS BOUNDARY SUIT

The Oklahoma-Texas boundary suit, in which a decision has recently been rendered by the Supreme Court of the United States, was of more than ordinary interest by reason of the large property values involved, the considerable cost of the litigation, and the extent to which scientific investigations were utilized. The value of the property, particularly the small part of it known to be oil bearing, can be estimated only in millions of dollars. The testimony in this case as submitted to the Supreme Court, exclusive of the attorney's briefs and arguments, amounted to more than five thousand printed pages. This testimony was accompanied by about five hundred photographs and more than one hundred original maps and charts, prepared especially for this case. The cost of printing the testimony exclusive of maps and engravings was in excess of twenty-five thousand dollars. The total cost of the suit to the litigants probably exceeded one half million dollars.

In its historic setting, this case dates back to a treaty made between this country and Spain, in 1821, approximately one hundred years ago, which was intended to define the boundary line between the United States and the Spanish possessions. The boundary established by this treaty, reaffirmed by succeeding governments, ultimately became the boundary on the Red River between the States of Oklahoma and Texas. The exact place of this boundary line on the river having been called into question, suit was brought in 1919 by the State of Oklahoma against Texas to which the United States became intervener. The evidence presented consists of scientific and lay testimony. Geologic and ecologic investigations for the United States and Oklahoma were made by L. C. Glenn, Isaiah Bowman, H. C. Cowles and L. L. Janes, and for the State of Texas by E. H. Sellards, R. T. Hill and B. C. Tharp. The topographic surveys and maps incident and necessary to these investigations were made for Texas under direction of Arthur A. Stiles, state reclamation engineer, and for the United States under direction of Robert Livingston. After testimony as to soil conditions had been presented by Texas, certain members of the United States Bureau of soils were called into the case by the United States, including H. H. Bennett and others. Chemical analyses incidental to Texas investigations were made under the direction of E. P. Schoch. In all a total of twenty-eight men appeared in this suit as expert and scientific witnesses.[1]

A previous decision of the Supreme Court rendered in 1921, following an earlier decision made in 1896, placed the boundary between Texas and Oklahoma as on the south bank of the river. However, it remained to be determined what constituted the south bank of the river, where on that bank the boundary line should be drawn, and in what way, and to what extent the river had changed its course in the one hundred years since the treaty was made.

Much of the scientific testimony was concerned with the habits of the river, particularly in building its valley lands. Witnesses for the United States and Oklahoma concluded from their investigations that the valley land in the upper part of the river with a few exceptions was not in existence in its present form one hundred years ago when this treaty was made. It was also held by these scientists that the method of building this valley land in the upper Red River is by a process called "island building" and not by the more common processes known on other rivers. According to this theory the valley land is built up through the formation of a succession of islands, followed by the abrupt transfer of the water of the river around such islands, this process being described by them as avulsion. The reworking and rebuilding of the valley lands by this method is assumed by these scientists or some of them to have progressed at such rate as to have completely reworked and rebuilt all valleys in the upper reaches of the river, with few exceptions, within the past one hundred years.

The force of these contentions will be appreciated when it is remembered that it is a well established principle of law recognized by both parties to this suit that when a river forming a boundary line changes its course by the usual process known as erosion and accretion, that is, by the more or less gradual washing of the banks at one place and the deposition of the washed material at another, the boundary line continues to follow the river and changes with it. On the other hand when a river owing to either natural or artificial causes abruptly leaves its channel and makes for itself a new channel the intervening land between the old and new channel remaining undisturbed, as in the case of ox-bow cut-offs, a change known as avulsion, the boundary line in such instances does not go with the river to its new channel but continues to follow the former channel. The theories advanced, if sustained, would have resulted in placing the state boundary line at or near the foot of the Texas bluff, thus throwing practically all of the river valley land of the upper part of the river into the State of Oklahoma. That is, under this interpretation Texas constantly loses by the shifting of the river, but never gains by deposition of sediments, the rate of loss progressing with such rapidity that practically the whole of the valley land in the upper stretches of this river has been lost to Texas within an interval of one century.

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[1] The evidence in full in this case appears in the records of the Supreme Court of the United States, No. 23 original, 1920, and No. 20 original, October, 1921, Volumes I to IX, 5,513 pages.

The investigations centered on, but were not confined to one particular valley in Wichita County known locally as the Big Bend into which the oil fields extend. Scientists representing the United States and Oklahoma maintained that one hundred years ago when this treaty was made, this valley, or such parts of it as may then have been in existence, was separated from the mainland by a channel of the river flowing at or near the Texas bluff. Trees in this valley in excess of one hundred years of age were said by the ecologists representing the United States to have had their inception on islands. These contentions, if sustained, would have placed this, as well as other Texas valleys, in the State of Oklahoma.

The State of Texas on the other hand maintained that neither the Red River channel, nor the sand stretch which borders the channel, nor any part of the channel or sand stretch lay adjacent to the Texas bluff in the Big Bend Area so recently as within the past one hundred years. With regard to changes in the course of the river, it was contended that in this river, as in other rivers, the change throughout the entire course of the river occurs in some instances by erosion and accretion and in some instances by avulsion, and that normally in this river where the land is being built up, as has been done in the past ages in the Big Bend Area, the change of the course of the river is by erosion and accretion. The larger valleys are regarded as in general exceeding one hundred years in age, at least in their older lands. Around the original nucleus of the valleys, in most instances, newer lands have been added from time to time, the controlling building process being by accretion. Ecologic studies indicate that the older portions of the Big Bend and other larger valleys have reached the climax stage of plant development, in this respect agreeing with the adjacent terraces and uplands. Under this interpretation the valley lands on the south side of the river belong wholly to the State of Texas throughout the entire course of the river where it forms the boundary.

The evidence presented in this suit may be classed as: (1) Physiographic, including discussion of the physical features of the valleys, such as sand dunes, their age and habits of building and shifting, sand bars, back valley streams, marginal fans, old stream channels and inter-dune depressions; (2) geologic, including discussion of sedimentation of river valleys in general, and such evidence as was available from fossils, particularly the more or less well mineralized bones of the buffalo and other animals formerly living in the valleys; (3) agrogeologic, including thickness, method of accumulation, age indications, alteration and succession of soils; and (4) ecologic, including relation of the vegetation of the valleys to that of the upland, as well as the age indication of the timber, shrubs and herbaceous vegetation of the valleys.

By the decision of the Supreme Court, now rendered, Texas retains the valley land up to the margin of the sand bed of the river, throughout the entire territory under controversy. In addition to the valley lands, counsel for Texas maintained that rights inherent in the treaty gave Texas possession to the waters edge, thus in places crossing more or less of the sand stretch which borders the river channel. This last named contention was not sustained in the majority opinion of the court although it is sustained in the dissenting opinion of Justice Mc. Reynolds.

The conclusions of the judges of the Supreme

Court based on the evidence relating to the age of the valley and the methods of building the valley land is indicated in the following extracts from the decision rendered.

EXTRACTS FROM THE DECISION OF THE SUPREME COURT OF THE UNITED STATES IN THE CASE OF OKLAHOMA VS. TEXAS, UNITED STATES INTERVENER. PP. 12-14.

Common experience suggests that there probably have been changes in this stretch of the Red River since 1821, but they cannot be merely conjectured. The party asserting material changes should carry the burden of proving them, whether they be recent or old. Some changes are shown here and conceded. Others are asserted on one side and denied on the other. A controverted one is ascribed to the so-called Big Bend Area, which is within the oil field. That area is now on the south side of the river and connected with the bluffs on that side. Oklahoma and the United States assert that in 1821 a channel of the river ran between it and the bluffs and that the river has since abandoned that channel. Texas denies this and insists that the situation in 1821 was practically as now. . . . It (the testimony of the experts) is so voluminous that it does not admit of extended statement or discussion here. We can only refer to important features and give our conclusions.

It (the Big Bend) is larger now than sixty years ago, but how much is uncertain. The enlargement is the result of intervening accretions. The habit of the river is to erode the outer bank of a bend and to accrete to the opposite bank. . . . On the outer part are physical evidences of the formation being comparatively recent. On the inner part are like evidences of the formation being old, among them being the presence of living trees more than a century old. One of the trees, a pecan, attained an age of 170 years. . . . To overcome the inference arising from the presence of the old trees, which were well scattered, testimony was presented to show that in 1821 these trees were all on islands, which afterwards were consolidated amongst themselves and with the land on the south side. We think this testimony is essentially speculative and not a proper basis for judgment. In this area, as elsewhere in the valley, a succession of depressions is found at the foot of the bluffs, and some testimony was produced to show that in 1821 the river, or a part of it, flowed there. It may be that the river was there long ago, but the testimony that it was there in 1821 is far from convincing. . . . Our conclusion is that the claim that the river, or any part of it, ran south of this area in 1821 is not sustained. So the boundary follows the cut bank around the northerly limit of the area.

E. H. SELLARDS

BUREAU OF ECONOMIC GEOLOGY
AND TECHNOLOGY
UNIVERSITY OF TEXAS

CHAUNCEY WILLIAM WAGGONER[1]

IT is fitting that the faculty of West Virginia University in general session assembled should pay appropriate tribute to the memory of Chauncey William Waggoner, head of the department of physics in the university, whose life and work have been so abruptly and tragically ended.

Professor Waggoner had leave of absence from the university for a year and was engaged in following up certain scientific investigations in the interest of a large industrial corporation. In pursuit of this work he was visiting Shreveport, Louisiana, where he met with the unfortunate accident that caused his death. He was thrown from a horse on October 24 and died on October 26.

Chauncey William Waggoner was born at Rock Bridge, Ohio, February 23, 1881. He was graduated from Ohio University at Athens, Ohio, with the degree of B. S., in 1904, and from Cornell University with the degree of A. M. in 1905. For five years he was student and instructor in Cornell University. He specialized in physics and won his doctorate in 1909. In the same year he was chosen professor of physics and head of the department of physics in West Virginia University and took up his work at once.

The thirteen years that followed were years of unusual growth and expansion in the university, especially in the departments of science, and Professor Waggoner, in sympathy with this development, reorganized the department of physics adequately to meet the growing demands upon it. He was always anxious that his department should be well equipped and able to do efficient work, and that the standards of science teaching and scientific research in the university should be uniformly high. Toward these ideals he worked with splendid enthusiasm.

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[1] Resolutions adopted by the Faculty of West Virginia University.

As a member in active attendance on the meetings of numerous national scientific bodies, he kept himself in close touch with the advances made in physics and engineering. He brought to this university and to his state valuable information gleaned from such associations, and shared it with others. He was himself active in research. As a result of his activities he was personally known to many of the leading physicists and engineers of the entire country, a number of whom have written letters of regret upon his untimely death and of highest appreciation for his personal friendship and for his contributions to science. The high estimate of his practical knowledge is attested by the fact that he served as consulting engineer to several large industrial corporations.

Before the establishment of a department of weights and measures in his state he labored gratuitously and tirelessly to secure the enactment of adequate and just legislation to regulate the use of weights and measures in the state, and after the establishment of a department of weights and measures in 1915, he worked zealously, as assistant commissioner of weights and measures, to help make this department useful and effective. His compensation for this was the satisfaction of knowing that he was helping to increase the sum total of honesty and square dealing among his fellowmen.

During the participation of the United States in the great war, Dr. Waggoner was chairman of the research committee of the state council of defense. He was also active in researches with industrial corporations engaged in the manufacture of munitions. In the early months of the participation of the United States in the war, he supervised the work of a class of young men taking training in radio signaling, and later had charge of a large signal corps training unit at the university.

Dr. Waggoner was broad in his views and many-sided in his interests. Native ability and scientific training guided him to well-based judgments. While tolerant of others' views, he was constructive and convincing in the presentation of his own views. Alert to every phase of civic and spiritual betterment, he showed himself in daily practice a sympathetic colleague, a kindly neighbor and a dutiful citizen. For young people he had especial sympathy, and he was active in encouraging their interest in religious and community life as in the pursuit of scientific knowledge. He had unusual zeal and energy. Hence, he labored without stint to advance the interests of youth, church, community and state. He had a strong moral courage. He therefore supported frankly and firmly, though with becoming courtesy toward adversaries, every cause which he deemed worthy of his espousal. His power of initiative and analysis made him a weighty advocate or a strong opponent. In him we find exemplified the finer qualities of scholar, teacher, colleague, neighbor and citizen.

ROBERT A. ARMSTRONG,
E. H. VICKERS,
F. A. MOLBY

JANUARY 10, 1923

SCIENTIFIC EVENTS

ANIMAL PATHOLOGY AT THE UNIVERSITY OF CAMBRIDGE

As has been noted in SCIENCE the senate of the University of Cambridge has accepted the offer of the ministry of agriculture of a sum of £30,000 to found a professorship of animal pathology. The London *Times* states that the foundation of the professorship is the first step towards the creation of an institute for research on animal diseases. It has long been felt with increasing keenness that the losses from disease among live stock have been unnecessarily large; that, in fact, a considerable proportion of these losses might be prevented by an extension of scientific research. This applies not only to those scourges which are widely advertised by the government measures adopted for their suppression, but to other more or less obscure diseases of which the farmer is aware, but about which the general public is ignorant. The aggregate losses from animal diseases amount to millions of pounds every year.

The expressed opinions of the farming community are said to have played a considerable part in inducing the ministry to make the present offer to Cambridge. Farmers have felt for some time that they could not go on bearing silently the losses caused by disease without making a determined effort to call in the aid of scientific research. Losses by disease may or may not be preventable, but whatever the possibilities in this direction, the need for research can not be denied.

The first duty of the professor when he is appointed will be to prepare his plans, and it is understood that the government departments concerned are prepared to consider favorably schemes involving a total expenditure on buildings, staff and upkeep of £100,000 in the next four years. After that period the financing of the institute will depend upon circumstances. The million pounds voted under the Corn Production Acts (Repeal) Act, 1921, will be exhausted, and in the present state of depression it is impossible to foretell what may happen. If, however, the professor of animal pathology and his colleagues make good, financial assistance will no doubt be forthcoming.

The site chosen for the new institute is appropriate. Its headquarters will be placed in an extension of the School of Agriculture, where the new professor will have for his colleagues, among others, Professor T. B. Wood, Professor R. H. Biffen, Dr. F. H. A. Marshall and Mr. K. J. J. Mackenzie, who will assist him in directing his work on sound agricultural lines. His windows will look into the new biochemical laboratory, which is being built for Professor F. G. Hopkins, the discoverer of vitamines: a few yards away is the Molteno Institute, where Professor G. H. F. Nuttall pursues his studies in parasitology; the university medical school is only just the other side of Downing Street. The necessary paddocks, stables and animal houses will be provided at the field laboratories, which are situated just outside the town.

THE STERLING CHEMISTRY LABORATORY OF YALE UNIVERSITY

ON April 4, 1923, Yale University will formally dedicate the Sterling Chemistry Laboratory, a $2,000,000 structure and the first building erected by Yale from the funds made available by the bequest of John W. Sterling. The date chosen for the dedication has a historical significance at Yale, since on April 4, 1804, Benjamin Silliman, the first professor of chemistry in Yale College, delivered his first lecture on this subject. The dedication of this building will be an international scientific event, since English, Scotch, French, Italian, Dutch and Canadian universities are to be represented by a delegate from each of these countries. It also will take place during the meeting of the American Chemical Society in New Haven, when two thousand or more American chemists will be in attendance.

The Sterling Chemistry Laboratory is said to be the finest material plant in the world for the teaching of chemistry and the prosecution of research work. Entering the building one comes into a spacious lobby or entrance hall, with walls of stone reaching up to a high arched roof. Thence through massive arches one passes into a large cross hallway, paved with stone and with fumed-oak beams supporting its ceiling. Along this hallway and opening into it are classrooms and offices. In the north of the hallway are storage and stock rooms, a delivery court, shops and the laboratory of industrial chemistry, reaching from the foundations of the building to its roof. In this enormous room are placed pieces of apparatus of factory size. With its two galleries, its traveling crane, its lines of shafting and maze of pipes, this appears indeed a chemical manufacturing plant.

Passing up an imposing stone stairway one comes to the main floor of the building. To the front and opening from a similar hallway extending for two hundred and fifty feet across the building are other classrooms and two large lecture halls. On the opposite side of the hall are the offices of the faculty members. Along the two sides of the building are two narrow halls opening into a multitude of small private laboratories. The outer walls of these are the outer walls of the building. On the west side of the building, the walls thrust out into a projection surmounted by a tower. Below is the great side entrance with iron gates and massive doors, through which heavy trucks may pass into the building. Above is the library, furnished in dark oak with comfortable chairs, ample desks and tables, and at one end a fireplace. About the walls are thousands of volumes of chemical text-books and bound journals.

The whole center of the building is a space approximately one hundred and eighty by two hundred and fifty feet which is devoted to teaching laboratories. With the exception of the industrial chemistry laboratory which goes through to the first floor, all of these laboratories are on a single level and all are covered with the saw-tooth roof peculiar to the modern factory. In the center of this section is the supply room, accessible by virtue of being at the intersection of two hallways and communicating by elevator with the large storage and stock rooms in the floor below. A feature of this part of the building is that none of the partitions which divide the teaching laboratories are "structural." This is essentially one enormous room under a single roof. The dividing walls are but the thickness of one brick and can be torn down and shifted if necessary without inconveniencing any other part of the laboratory This feature, together with the easy accessibility of the plumbing and wiring, gives the flexibility which is so necessary if any building of this sort is to be permanent.

THE CIRCULATION OF AGRICULTURAL NEWS

At a recent staff meeting of the New York Agricultural Experiment Station at Geneva, Dr. R. W. Thatcher, director of the station, read a report on the station news service for 1922. Beginning with January of last year items of timely interest on the work of the experiment station have been sent at frequent intervals to newspapers and farm papers, with the result that the station activities have been brought to the attention of a much larger number of persons than would be possible in any other way.

According to the report, a total of 152 different news stories dealing with the work of the station were sent out during the year. By means of returns from clipping bureaus, the station authorities are able to check up on the use of these stories in the newspapers, although the clipping bureaus undoubtedly fail to see many of the items. A close check is also kept on the stories appearing in farm papers received and in this way and through the clipping bureaus some idea is obtained of how extensively the news material is used.

During the past year accounts of the station work appeared 3,559 times in different papers. Of this number more than 1,200 were in daily papers, while 1,867 were in weekly newspapers. Items appeared 206 times in farm papers and 283 times in the county farm bureau publications of this state. Papers as far north as Maine and Canada, as far west as the Pacific Coast, and as far south as Tennessee and Virginia made frequent use of the station news service. It is estimated by the station authorities that the papers carrying the station news material had a total circulation of more than 45,000,000, and it is certain that many papers of which there is no record carried the station news items. The station officials expressed a keen sense of appreciation of the generous amount of space devoted to station news in the various papers.

The news service was inaugurated at the time that the mailing lists were revised along subject matter lines and the bulletin editions greatly reduced. The bulletins are now sent only to those who have asked to receive station publications on certain subjects with the idea that such a system of distribution will insure the bulletins going to those who will make the best use of them. The news service supplements the bulletin publications and renders a valuable service in calling attention to the recent findings and developments of the work.

THE ENGINEERING SOCIETIES LIBRARY

The United Engineering Societies maintain a large library in the Engineering Societies Building, 29 West Thirty-ninth Street, New York City. It contains about 117,000 volumes and 32,000 pamphlets. While these are not entirely indexed, in the last three years about 150,000 cards have been added to the catalog. There is now available 50,000 subjects presented to prospective readers in a systematic and logical relation. These subjects are handled in two different ways: The searcher who wishes to exhaust his field will find all entries arranged from the large group down to the most minute in one place. The casual reader who wants a minute subject has an alphabetic subject index available.

The attendance at the library during 1922 was 26,000 persons. Enquiries made by telephone and correspondence brought the total number of users of the library up to 34,000. The library added 3,353 books to its collection during the year. Service bureau orders, including searches, translations and photoprints, were sent to forty-six states and to the Argentine Republic, Australia, Belgium, Bermuda, British West Indies, Canada, Chile, Cuba,

	1916	1919	1920	1921	1922
Number of words	307,904	227,300	352,970	289,000	343,130
German	70.4%	40%	62%	68.4%	72.6%
French	25.3	42	20	23.4	10.3
Italian	1.7	4	4	1.8	6.4
Scandinavian	1.0	7	4	1.3	1.9
Portuguese	.97	....	....	....	....
English	.56	....	....	....	....
Spanish	.07	3	....	2.3	1.0
Dutch	....	4	....	....	1.2
Russian	....	....	10	....	3.0
Japanese	....	....	....	2.0	2.6

Haiti, India, Italy, Japan, Mesopotamia, Mexico, Norway, Rumania, Spain, Sweden, Switzerland and the United Kingdom.

The accompanying table gives the available data concerning the number of words translated during the past few years, showing the relative amounts of German and French translated before, during and after the war.

H. ANDREWS

COMMITTEE MEETING ON STANDARDIZATION OF STAINS

ON March 2 at the Chemists Club in New York City there was held a meeting of the Executive Committee of the Commission on Standardization of Biological Stains. The members of this committee are: H. J. Conn, Geneva; F. B. Mallory, Boston; L. W. Sharp, Ithaca; J. A. Ambler, Washington, D. C., and S. I. Kornhauser, Louisville, Ky. The meeting was also attended by C. H. Herty to represent the Synthetic Organic Chemical Manufacturers' Association, and by F. P. Garvan and W. F. Keohan to represent the Chemical Foundation.

At this committee meeting the very encouraging results of the work were reported. It was shown that already the stains available in America are in practically all cases as good and sometimes better than the best of the pre-war stains. The most important fact brought out at this meeting was that while the pre-war stains were standardized only in an empirical way, by buying large batches without knowing the exact composition of the dye, they must now be standardized on the basis of pure chemicals.

The reason for this is because it is proving that in some cases the impurities present in the pre-war stains were very necessary. Sometimes these impurities were other dyes and sometimes supposedly inert materials like dextrin. In all such cases the task plainly before the commission is to find out what the impurity is which was responsible for the good staining qualities of the impure product. Then in the future the users of stains must demand that these impurities be present, not as impurities, but as intentionally added ingredients. When this has been done and the products are labeled and used accordingly, the American stains will become standardized in a true sense of the term.

Very shortly the commission will begin issuing certification of definite batches of stain that it has found satisfactory. These stains will be put on the market under a special label bearing the name of the commission. Users of stains must be on the lookout for products bearing this label. Buyers of stains should also be on the watch for spurious imitations of this label put out by unreliable concerns. Any statement of certification not bearing the name of the commission is a certification by the manufacturer or dealer himself, and therefore has no value. A cut of the commission label will appear in this journal as soon as it is ready for the use of the manufacturers of stains.

The Chemical Foundation has agreed to support the work of this commission financially.

H. J. CONN

THE SOLAR ECLIPSE OF SEPTEMBER 10

THE State Department transmits to the Smithsonian Institution a communication from Mr. Leighton Hope, consul in charge at Ensenada, Mexico, on the conditions at Ensenada with respect to the observation of the total solar eclipse of September 10, 1923. An abstract of the consul's report is as follows:

The town is on the west coast of Lower California. The eclipse is total at Ensenada at 2:02 p.m. Weather conditions there promise to be excellent. The town may be reached from San Diego by auto stage line over a rough but passable route in about five hours. If reached by sea it would probably require a special vessel as the two Mexican lines carrying passengers and freight from San Francisco and Los Angeles have somewhat irregular schedules at intervals of something like two weeks. Various points of vantage along the path of totality can be reached from Ensenada by automobile or by burro pack train, but facilities for such transportation are extremely limited there so that transportation should be arranged for in advance, probably at San Diego.

Ensenada is a small village with no hotel, one or two small rooming houses and a few Chinese restaurants. Camping out, however, would be pleasant. Meat, fresh vegetables, fruit and melons can be had at that season at reasonable prices and in sufficient quantity. Other supplies should be imported. Servants, cooks and ordinary labor will be difficult to obtain on the ground.

The town of Tia Juana, Mexico, near San Diego, has an unsavory reputation and it is not unlikely that criminals from there might visit Ensenada at the time of the eclipse, so that each member of observation parties should have a passport or other documents showing his nationality, identity and the purpose for which he is in Ensenada. Local authorities express themselves as anxious to do everything possible for the comfort of the guests on this occasion.

Provision for admission of apparatus duty free would have to be effected through the national government at Mexico City.

C. G. Abbot,
Assistant Secretary

AWARD TO PROFESSOR MICHELSON[1]

Mr. Post-Wheeler, who is on the staff of the American Embassy, attended the annual general meeting of the Royal Astronomical Society on February 9 to receive the gold medal on behalf of Professor A. A. Michelson, who was unable to be present himself.

Professor Eddington gave a most illuminating address on the reasons of the award, explaining that the necessity for the great separation of the mirrors receiving the pencils of light from the stars was to give sufficient difference of length of path to enable the rays from the two extremities of a diameter of the star to be in opposite phase, so that the bright regions of the image from one extremity should fall on the dark regions of the other and so cause the fringes to vanish. It was mentioned that the method had been successfully applied to the measurement of the diameters of Jupiter's satellites, but the stars seem to have been considered hopeless, till recent physical work on the distribution of energy in the spectrum led to the conclusion that the red stars have such dull surfaces that the brighter ones must have appreciable discs in order to give so much light.

The actual figure had been calculated for Betelgeuse, and the observed diameter afterwards proved to be very close to it.

Some letters from Mr. Pease were read, in which he described the great practical difficulties that were incurred in applying the method of diffraction fringes, and the long-continued trials that were finally crowned with success. One of the earliest successes was the determination of the orbit of Capella. This gave, for the first time, a really accurate value of the mass and absolute magnitude of a giant star, which had already proved of use in the physical studies that were being made on these bodies.

A recent interesting development of the Betelgeuse measures was that the diameter came out different at different times, to an extent much beyond the probable errors of the measures. Attempts were being made to correlate these changes with the variable brightness and variable radial velocity of the star, but it will be necessary to carry on these measurements for some time before a definite conclusion could be reached.

Professor Eddington went on to point out that the famous Michelson-Morley experiment, for which the Copley medal of the Royal Society was awarded in 1907, though not specially contemplated in the present award, might be considered as coming within its terms; for the measures were made by interference methods, and the question whether the movement of the earth through the ether could be detected was one of the highest astronomical interest. He knew that their medallist was disappointed at the negative result, but the whole of the system of relativity had been founded upon it, so that in his (Professor Eddington's) opinion it was more fruitful than a positive result would have been.

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[1] From *Nature*.

In handing the medal to Mr. Post-Wheeler he asked him to transmit to Professor Michelson their congratulations on his success and their good wishes for the long continuance of his fruitful labors. Mr. Post-Wheeler replied in a few suitable words expressing his sense of the pleasure it gave him to be there as the representative of America, and thanking the society for the honor they had conferred upon his country in the person of Professor Michelson.

SCIENTIFIC NOTES AND NEWS

We regret to record the death of Edward Williams Morley, professor of chemistry at Western Reserve University from 1869 until his retirement as professor emeritus in 1906. Dr. Morley, who was eighty-five years of age, was president of the American Association for the Advancement of Science in 1895.

The council of the University of Paris has decided to confer the honorary degree of doctor of medicine on Professor W. W. Keen, of Philadelphia, and Professor Golgi, of Pavia.

The council of the Royal Society has recommended for election the following: Dr. E. D. Adrian, university lecturer in physiology at the University of Cambridge; Dr. W. Lawrence Balls, chief of the experimental department of the Fine Cotton Spinners' Association; Dr. Archibald Barr, regius professor of civil engineering and mechanics in the University of Glasgow from 1889 to 1913, now chairman of Barr and Stroud, Ltd., Glasgow; Dr. C. H. Desch, professor of metallurgy in the University of Sheffield; Dr. E. Fawcett, professor of anatomy in the University of Bristol; Dr. F. Horton, professor of physics in the University of London; Dr. R. T. Leiper, professor of helminthology in the University of London School of Tropical Medicine; Professor J. W. McBain, physicist and chemist; Dr. J. J. R. MacLeod, professor of physiology in the University of Toronto; Dr. G. A. K. Marshall, director of the Imperial Bureau of Entomology; Sir Douglas Mawson, leader of the Australasian Antarctic Expedition, 1911-1914; Dr. W. H. Mills, chemist; Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B. C.; Dr. R. H. Procter, emeritus professor of applied chemistry in the University of Leeds, and Dr. W. Wilson, professor of physics in the University of London.

Major William Cain, Kenan professor emeritus of mathematics in the University of North Carolina, has been awarded by the American Society of Civil Engineers the J. James R. Croes Medal for his paper on "The circular arch under normal loads."

A dinner was tendered Dr. Emanuel Libman on February 23 by his associates and pupils as a tribute to his twenty-five years of active service as associate pathologist to Mount Sinai Hospital, New York City. Dr. Frederick S. Mandlebaum, pathologist of the hospital, was toastmaster. Following the dinner, it was announced that a fund of $25,000 had been completed to found the Emanuel Libman fellowship in pathology.

Dr. John B. Deaver, former professor of surgery in the School of Medicine of the University of Pennsylvania, has been elected emeritus professor of surgery.

Professor Lester P. Breckenridge, chairman of the department of mechanical engineering of Yale University, will retire from active teaching at the end of the present year. Professor Breckenridge went to Yale University from the University of Illinois fourteen years ago.

The University of Cambridge will confer the degree of M. A., *honoris causa*, on Mr. Humphry Gilbert-Carter, director of the botanic garden.

The Foulerton Award of the British Geologists' Association for the year 1923 has been given by the council to Mr. A. S. Kennard. We learn from *Nature* that Mr. Kennard was associated with Mr. M. A. C. Hinton in the paper on "The relative ages of the stone implements of the lower Thames valley," and with Mr. B. B. Woodward in the production of several important papers on the Post-Pliocene non-marine mollusca of England and Ireland.

THE Prix de Carthage, a biennial prize founded in 1921 for scientific or historical work, has been awarded to Dr. Nicolle, of the Pasteur Institute of Tunis, for his investigations of typhus fever, kala-azar, trachoma and Malta fever.

SEÑOR DON JOSÉ SERRATO, who was elected president of the Uruguayan Republic last November, has now entered upon his work. Señor Serrato is a surveyor and engineer, having been professor in the faculty of mathematics in the University of Montevideo.

CHARLES R. MANN, since 1917 an educational adviser to the war department, formerly associate professor of physics in the University of Chicago, has been appointed director of the American Council of Education.

PROFESSOR E. I. TERRY, of the department of biology at Middlebury College and manager of the Battell Forest, has resigned his position to accept a position as forester of the Massachusetts Forestry Association.

RICHARD V. AGETON, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

EDGAR S. ROSS, for a number of years engaged in research dealing with production of metallic tantalum and columbium, has accepted an industrial fellowship at the Mellon Institute of Industrial Research, University of Pittsburgh.

PROFESSOR W. L. BADGER, professor of chemical engineering, University of Michigan, Ann Arbor, Michigan, is taking a year's leave of absence beginning February 1. He expects to continue his research work on evaporator design in Ann Arbor.

DR. JOHN C. MERRIAM, president of the Carnegie Institution; Dr. Marshall H. Saville, director of the Heye Museum, and Mr. William Barclay Parsons, chairman of the Archeological Institute of Yucatan, have been visiting Yucatan with a view to instituting investigations on the Maya civilization.

SENATOR E. F. LADD, formerly professor of chemistry and president of the North Dakota College, who plans to visit Russia this summer.

PROFESSOR ELMER S. RIGGS, of Chicago, is heading the Chicago Field Museum expedition which has left Rio Gallegos, in South Argentina, for a five-year exploring trip in the heart of Patagonia.

PROFESSOR S. D. TOWNLEY, who during the present quarter has been working at the Harvard College Observatory preparing a catalogue of the variable stars, returns to Stanford University this month.

MISS MINA L. WINSLOW, curator of mollusks in the zoological museum of the University of Michigan, will leave for Europe in the near future to study in the various museums.

DR. VERNON KELLOGG, of the National Research Council, gave a series of three lectures at Princeton University on March 13, 14 and 16, on the Louis Clark Vanuxem Foundation, under the title "Kinds of mind." The lectures reviewed the present status of knowledge of the influence of heredity in determining the character and capacity of mind in the lower animals and man. They will be published in book form by the Princeton University Press.

UNIVERSITY AND EDUCATIONAL NOTES

A BILL has recently been passed by the Oregon legislature and signed by the governor appropriating $200,000 to the University of Oregon Medical School at Portland for maintenance for the next biannum. This appropriation bill was one of the few that were not cut by this legislature. At present the school has an enrollment of about 200 students and requires three years of collegiate premedical work for admission.

THE Cheney Brothers, silk manufacturers, of South Manchester, Connecticut, have offered to pay Yale University $1,000 a year for two years for a fellowship in organic chemistry in the graduate school.

FOR the purpose of furthering research in engineering, Mrs. Mary E. Bell has offered to Cornell University a memorial in honor of her son, Harold Ingersoll Bell, who was graduated from the College of Civil Engineering at Cornell in 1905 and died in New York City two years ago. The memorial is in the form of an endowment fund of $5,000, the income from which shall be used to purchase equipment and supplies for research in hydraulic engineering and related fields.

SIR NORMAN WALKER, of Edinburgh University, Scotland, has offered the College of Medicine at the University of Iowa his medical library through Dr. Walter L. Bierring, Des Moines. Sir Norman visited the university two years ago in company with a commission of eminent European physicians and surgeons. He has announced that the gift is in appreciation of the medical work being done at the university. He also states that he expects to send his son to the University of Iowa to complete his medical training.

A COLLOIDS research laboratory in the University of Manchester has been established with £11,842 given for that purpose. Mr. D. C. Henry, at present a lecturer in chemistry, has been appointed lecturer in colloid physics and will take charge of the laboratory, which will be known as "The Graham Research Laboratory."

DR. GEORGE GRANT MACCURDY, curator of anthropology and assistant professor of prehistoric archeology in Yale University, has been promoted to professorial rank with the title of research associate.

DR. HUDSON BRIDGE HASTINGS, of Wellesley Hills, Massachusetts, who has been investigator of business and economic questions under the Pollak Foundation for Economic Research, has been appointed professor of administrative engineering at Yale University.

MR. J. L. SHELLSHEAR, demonstrator in anatomy at the University College, London, has been appointed professor of anatomy at Hongkong, China.

DISCUSSION AND CORRESPONDENCE

AN EXCEPTIONALLY DARK DAY IN NEW YORK

AT rare intervals days occur in New York of such exceptional darkness as to attract general attention. A remarkable day of this kind was February 28, 1923.

The morning dawned dark, with a few flakes of snow falling until about nine o'clock. The darkness increased toward noon. It was most intense from nine until eleven. At that time the aspect of the city was that which might be expected at night. The shops and shop windows were lighted. Offices, even on the highest floors of the skyscrapers, found it necessary to turn on the electric light. The street cars and taxicabs were lighted as in the evening. For an hour there seemed to be no change in the density. After noon there was a perceptible improvement; but the whole day was unusually dark.

The next day was bright and clear, with a good westerly breeze. It was possible to compare the light on the dark day with that on a normal one. Print could be read as well at 6:15 P.M. on March 1 as at 10:45 A.M. on February 28. Sunset was at 5:46 on March 1. In other words, the light at a quarter of eleven in the morning of the dark day was about the same as it would normally be half an hour after sunset in the same place. The place where this comparison was made was Fifth Avenue and Forty-third Street.

In the streets the atmosphere was clear during the darkness. There was no appearance of fog. Many of the tall buildings could be seen to their tops. It was noticed that smoke and spent steam rose vertically from their roofs. The sky was dark gray.

It is seldom that even very dark days give rise to so much comment. On this occasion the public seemed to feel that it had a special reason to be alarmed. On February 28 the newspapers announced with sensational headlines that the celestial body Beta Ceti had blazed forth suddenly in the sky to the great interest of astronomers. An eminent scientist was quoted as saying that if such a change occurred in our sun, and such changes were not uncommon, the population of the earth would be annihilated. The sudden brightening was of the utmost practical importance. The dark day was therefore looked upon by thousands with alarm.

It has seemed worth while to inquire into the atmospheric conditions which prevailed at

New York and vicinity on February 28 in the hope of finding an explanation of the darkness. I am indebted to the officers of the New York office of the United States Weather Bureau for an opportunity to examine their records of temperature, pressure, wind, precipitation and fog over the northeastern part of the United States and especially along the coast in the neighborhood of New York City.

The day was seasonable as to temperature, with a maximum of 37.4 degrees Fahr. and a minimum of 30. The barometer was 29.97 at 8 A.M. and 29.89 at 8 P.M. Between ten and eleven, when the darkness was greatest, the temperature, according to the official records, was 35. This was at the top of the Whitehall Building; in the streets in the center of the city it was doubtless several degrees warmer. It may be taken as sufficiently accurate to say that the temperature throughout the very dark period was just above the freezing point.

The weather was cloudy throughout the entire region about New York, with slight precipitation in the west and north. Fog was reported along the coast from Cape Cod to the Delaware capes.

The wind was E.S.E. from 8 to 9:15 A.M., then mostly S.E. to 10 o'clock. From 10 to 10:55 it was S.S.E. At 10:55 the wind began to shift to the S., then S.W., W. and N.W. to N. It took fifty-five minutes to complete this change. From noon to 1:45 the wind blew from the north; then it veered to the N.E., back to north and was N.E. at 5:15. It blew from nearly all points of the compass, starting from the direction of the sea and continuing so until the darkest period was passed. There was a sensible lightening when the shift to the south occurred.

The velocity of the wind was five miles per hour up to 9 A.M., then 3 m.p.h. to 9:30, 2 m.p.h to 11:25 and 4 m.p.h. to noon. From noon onward to the end of the day, the velocity was from 7 to 8 m.p.h. The period of greatest darkness was the period of least wind. It grew lighter when the wind veered to the south and began to blow a little harder.

The foregoing facts appear to afford a satisfactory explanation of the darkness. During the morning, large masses of air carrying a heavy load of fog were driven very slowly back from the sea. It is probable that they encountered resistance from currents moving in the opposite direction which became noticeable later in the day, and, in consequence, became piled up to a great height. Whether it was due to this cause or not, the thickness of the fog blanket was certainly great. The warmth encountered at the surface of the earth dispelled the fog at the surface and so produced the effect of a city covered with a very heavy, low-lying cloud. When the wind shifted and grew stronger much of the cloud was blown away.

It would be interesting to know how much of the darkness was properly attributable to the smoke of soft coal and other inferior fuels due to the scarcity of anthracite coal. The smoke and fumes and dust produced by the city, and noticeable in the atmosphere, except on the brightest days, would have added materially to the darkness had there been no unusual amount of soft coal in use. The smoke added to, but did not cause the darkness.

It is proper to conclude that the darkness was caused by a great, low-lying and nearly stationary cloud into which countless chimneys were pouring smoke of various degrees of density.

GEORGE A. SOPER

THE MASS LAW AND STATISTICAL EQUILIBRIUM

THE recent note by Professor Neuhausen[1] on the reaction of slightly soluble salts calls attention to the fact that, while in the past the common error has been to apply the mass law to solutions too concentrated, it is equally fallacious to attempt to reason from it when the solutions are too dilute. Gibbs pointed out that thermodynamics is only an approximation to the exact science of statistical mechanics, the approximation being the better the larger the number of molecules in the system under consideration. Thus by extrapolation from the data for the vapor pressure of tungsten at high temperatures we can calculate the vapor pressure of tungsten at temperatures where there should be only one tungsten atom per liter in the vapor in equilibrium with the solid.

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[1] SCIENCE, N. S., 57-26, 1923.

Such a calculation may have thermodynamic significance in some cases but it would be absurd to say that a tungsten wire maintains a statistical equilibrium with an atmosphere around it of one atom per liter. The absurdity becomes more obvious when we consider that a very high vacuum contains 10^{10} molecules per liter.

Similarly any calculation from thermodynamic data that one mercury ion exists per 1,000 liters is quite meaningless. If the precipitated mercuric sulfide is in statistical equilibrium with the solution, as appears probable, the absolute number of mercury and sulfide ions per cubic centimeter of solution must still be very great. It is almost an axiom of nature that gross experiments can not give us evidence as to the presence of a single ion or molecule in a given portion of matter.

The question as to the reaction of solutions with solids is answered by the knowledge of the structure of polar crystals furnished by X-ray methods. Since the ions are shown to exist as such in the crystal, the mechanism of reaction is not different than in solution. It is probable that a salt goes into solution one ion at a time although recombination may take place between ions after they are in solution.

WORTH H. RODEBUSH

UNIVERSITY OF ILLINOIS

"WHAT IS A PLANT?"

IN SCIENCE for February 9 Professor Martin in an article on "What is a plant?" laments his unsuccessful attempt to find a suitable definition of a *plant* "when introducing the subject of botany to college classes."

Assuming that one can be found, is it necessary that the beginning student learn the definition of a plant? Will he know anything more about a plant after learning the definition than he knew before? It seems a bit illogical to attempt definitions before the student has any basis for them. When the word *plant* is mentioned, most beginning students, I imagine, think of some such organism as a tree, a bush, a weed, or a grass. And at that stage of the game such a conception seems far more desirable than an abstract one involved in a definition covering organisms the student has never seen and embracing ideas for which he has no data to support.

Suppose we let undisturbed the student's "indefinite" conception of a plant. Let him find out by laboratory exercises or field work how his "plant" is constructed. Show him by experiments how his "plant" lives, manufactures its food, grows and reproduces. Let him study and get similar data for ferns, mosses, liverworts, algae, fungi, bacteria. All this time he will have been learning *about* plants, their similarities and differences, their processes, their habitats, their relations to him. It appears that then, and only then, will the student be in a position to appreciate plants, their evolution, their relationships and their classification. It will require little effort on the part of the instructor for the student to realize that his earlier conception of a plant needs considerable modification.

If a plant must be defined, let us wait until the student has seen some illustrative material; until he has learned something about processes and structures of things he has no hesitancy in calling plants; and until he has made his own observations on some of the different organisms we call plants. At that time the student will be able to make his own definition based on what he has observed. Such a definition will not only not be abstract and beyond his grasp, but will be his *own*—of tremendous pedagogical significance.

L. H. TIFFANY

THE OHIO STATE UNIVERSITY

THAT PLANT

SOME ten years ago a high school girl wrote to me asking for a definition of a plant. Probably she wanted to floor some opponent in an approaching debate. After racking my brain for several days I wrote, "A plant is a living thing which manufactures its own food from the raw materials of earth and air, or one whose ancestors did so." I have used this definition ever since in my botany classes, but rather as a joke than as a serious matter. But the students take it seriously enough and usually commit it to memory. In substance it is obviously identical with that proposed by Professor Martin (SCIENCE, February 9, 1923), only mine is more prolix. If one must have a definition, I know of nothing better. It is particularly useful in showing that definitions are at best a mere makeshift, and very dangerous. Sometimes I insert after the word air "by the agency of light and chlorophyll." The clause relating to ancestors, however, makes the diagnosis of a plant quite impossible, and indeed introduces some very hypothetical material. We try to reach the conclusion that the statement of a real definition requires the contents of at least one book on general botany, with suitable lectures and laboratory experience or field work, and that the definition can be improved by more and more of such study. If there is a better definition, let us have it.

HENRY S. CONARD

GRINNELL COLLEGE

"EROBIC"

I HAVE read with very great interest the article on the "Bacteriology of Influenza," but I want to make one suggestion in reference to the spelling of "Erobic" and "Anerobic." This, it seems to me, ought to be "Ærobic" and "Anærobic."

I am fully converted to the use of the "e" instead of "æ" and "œ" as a rule, but in "erobic," for instance, "er" misleads one as to its meaning, as it comes from the Greek "ær." The same is true of "anerobic." It seems to me very clear that "æ" should be retained in this case, as an exception.

I confess, when I first read "erobic," I wondered what the word meant. My first idea was of an obscure reference to "eros" in "erobic." I was quite misled, and it took me an appreciable time to determine that it meant "ærobic." I hope that the spelling of these two words in this number of SCIENCE will not be continued.

I am a member of the consulting committee of the Simplified Spelling Board, and therefore am prejudiced in favor of the "e" instead of "æ" or "œ," but this, I think, goes beyond the mark that even the Simplified Spelling Board justifies.

W. W. KEEN

PHILADELPHIA
FEBRUARY 15, 1923.

QUOTATIONS

GIFT TO THE ROYAL SOCIETY

THE magnificent gift, which we announce this morning, by Sir Alfred Yarrow to the nation, through the Royal Society, of £100,000 for the advancement of scientific research should serve two purposes. It should be of most substantial help to numbers of investigators who are hampered or depressed by want of funds, and, as it throws the heavy responsibility of administration upon the Royal Society, it should serve to rehabilitate the illustrious institution in the eyes of those who are concerned not so much with science itself as with the politics of science. To touch on this second point first. There can be no question that Sir Alfred Yarrow, who is himself an honored member of the Royal Society, has done wisely in entrusting his fund to the society, for there is no other body possessed of traditions, prestige and authority to equal it in the kingdom, or, indeed, in the world. But of late years there has been a strong disposition to criticize the society's attitude towards the practical affairs of life. It has been felt that it has often preferred a dignified position of aloofness towards current interests, and it has seemed to let go by default some of its unique claims to be the real leader and adviser of the nation in scientific administration. It ought, one might argue, to be the invariable channel through which private benefactions to science should be directed. It ought to have a controlling voice in the application of government grants for scientific purposes; it ought, in short, to be as thoroughly active in practical matters as its individual members are in their own spheres of study. The obligations which this princely endowment now casts upon it should help substantially to enhance its authority. From this point of view alone Sir Alfred Yarrow's gift will, we believe, be welcome; for the Royal Society is of such a composition that its voice can never be negligible; its opinion on all matters connected with science must always be of paramount influence, and no one who has the interests of science or of knowledge at heart would care to see it miss its opportunities. We urged considerations of this kind last December, when the new council was appointed; and now the society has a brilliant opportunity of making good the ground that some of its sincerest well-wishers may have feared that it had lost.

As for the need of such an endowment for research there can be no question. The nation is not nearly scientific enough, or, to say it plainly, does not know nearly enough. Yet on knowledge, and on the pursuit of knowledge, the welfare of its citizens and the prosperity of its industries increasingly depend. Sir Alfred Yarrow's reasons for making this gift for scientific research are stated in his letter, and they are incontestable. He recalls the dangers to which lack of science, or ignorance, exposed us in the war and the advantage which the country reaped then and before from the labors of its scientific investigators. This testimony to "pure" science, as it is called, is all the more forcible in that it comes from a mind which has been devoted over many years not only to the application of acquired knowledge in shipbuilding and engineering, but also to its theoretic extension in the laboratory. It is on quiet laboratory work that everything in the long run depends. The Royal Society by its rules and traditions consists chiefly of persons engaged in the pursuit of knowledge for its own sake, and they are therefore least likely to be misled by the desire for immediate fruits. Sir Alfred Yarrow has left the society free as to the mode in which the capital or the income of his gift is to be expended, but he declares his preference for the adequate payment of scientific workers and for the provision of apparatus and facilities rather than the erection of costly buildings. He recognizes that conditions may alter from time to time, and suggests that if rules are framed for the administration of the fund, these should be revised at least every ten years. The suggestions are as prudent as the gift is generous. The nation will expect the Royal Society to translate into action the wise intentions of the donor with corresponding sagacity.—*The London Times.*

SCIENTIFIC BOOKS

DR. JORDAN'S AUTOBIOGRAPHY[1]

DR. JORDAN has chosen a most apt title for his autobiographical volumes. It is a "man," in the meaning of the accented use of the word, of whose life from childhood to seventy we are told in this book; and the activities and achievements of this life are revealed rather in the form of a record of the succeeding days and days' work of this life, with all their crowding and various activities of student, teacher, scholar, administrator and publicist, than in the form of an organized grouping of these activities and interests according to subject. This manner of treatment, chronological, inclining toward the diary form, has its drawbacks of diffuseness and mixing of subject matter and, one must perhaps admit, of overmuch detail, to the reader interested primarily in one or more of those important subjects, such as reform in university methods, introduction of the evolutionary point of view into the teaching of biology, the relations of science to every-day life, the encouragement of internationalism and pacifism, and what not else to which Dr. Jordan has so valuably contributed. But it has its great advantages to the reader interested in following closely the development and unremitting activity of a great personality. It reveals the methods of a highly intelligent and informed man, of robust, forthright character, working always with a steadfast aim to be useful to the youth and to the public and government of the American nation; the methods of a man intent on making use of every least as well as largest opportunity, with entire disregard of personal advantage or hurt, to contribute up to the very limit of his power to the advancement of the higher civilization of America and the world. As such it is a fascinating, stimulating and really ennobling record of the "days of a man."

Dr. Jordan tells interestingly of his childhood, in a manner always influenced, but never deadened, by the scientific student of heredity. He describes his days as pupil at home in the village of his birth in Western New York, then in a near-by academy, and finally as college student, beginning with seventy-five dollars in his pocket, at Cornell. His double interest in science and literature, maintained all through life, revealed itself from the beginning of his days of understanding. This story of adolescent development is seizing; one wishes there were more of it.

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[1] *The Days of a Man*, being memories of a naturalist, teacher and minor prophet of democracy. By David Starr Jordan; two volumes, illustrated, 1922. World Book Company, Yonkers-on-Hudson.

It was in the Cornell days that he made those important contacts and friendships with a group of young men devoted to scientific study, among them Branner, Comstock, Dudley, Copeland, and Kellerman, which had a lasting influence on his life. And it was at Cornell that he came to know its famous first president, Andrew D. White, who was to have such an important part in determining his selection as the first president of Stanford, and such an influence on Jordan's own attitude and efforts as university president in Indiana and California.

In 1873, Dr. Jordan, only just graduated from Cornell, was a member of that famous first, and only, summer class of Louis Agassiz on Penikese Island. (A second class, of which Jordan was also a member, was held next summer under the direction of Alexander Agassiz and Burt G. Wilder. This ended the Penikese Island experiment.) Here young Jordan came to know Brooks, Whitman, Minot, Faxon, Fewkes and others, all since famous in scientific annals. Agassiz made a great impression on Jordan, probably the greatest impression ever made on him by any man of science. One constantly meets references to Agassiz and his point of view and methods all through Dr. Jordan's two volumes.

After Penikese, begins the record of the days of the teacher and investigator of natural history in various collegiate institutions, as well as of the work of the wide-travelling field naturalist already specializing in ichthyology, a special interest which has been maintained to the very present day. His first fish-hunting trip to the South came in 1876; he made a second trip there in the next year and still a third in 1878. It was in 1877 that he made his first trip to Washington, becoming acquainted there with Baird, Gill, Coues, Dall, and Ridgway, the result of which was to make connections with the Smithsonian Institution which, with later connections made with the U. S. Bureau of Fisheries, were to give him unusual opportunities for the faunistic and taxonomic work on American fishes that soon resulted in making him the first American authority in this field.

In 1879 Jordan became professor of natural history in the University of Indiana. He taught botany, zoology, physiology and geology. This was only forty years ago. Now Indiana has a department of botany with one professor and three associate professors, a department of zoology with three professors and one assistant professor, a department of physiology with one professor and one assistant professor, and a department of geology with two professors, one associate professor and two assistant professors.

In 1880 Dr. Jordan made his first trip to California and the Pacific Coast. The first of his many trips to Europe was made in 1879. On January 1, 1885, he became president of Indiana University. In 1891 he was chosen by Senator Leland Stanford and his wife, the founders of Leland Stanford Junior University, to be its first president. It was a privately endowed university established, under extraordinary conditions, on the west shore of the long southern extension of San Francisco Bay, about thirty miles south of the city of San Francisco, in the middle of a great grain and stock ranch where fast trotting horses were being bred. Dr. Jordan had been recommended to the Stanfords for this position by Andrew D. White of Cornell.

So much, and perhaps too much for the fair balancing of this review, concerning the events in Dr. Jordan's life recorded in the first half of the first volume of the "Days of a Man." But the events of the days from 1881 to the present, told in the remaining three quarters of the book, are more familiar to us. They need no such detailed cataloging. It is in these thirty years of never abated activity as educator, scientist and publicist, that Dr. Jordan won his present national and international reputation. From 1893 on I have known him intimately, admiringly, reverently. I have been privileged to work with him in classroom and field, and to play with him in mountains and tropic islands. His active brain, ever driving him and all of us around him to constant effort; his freedom from convention and hampering tradition; his intelligent progressivism; his high honesty to his high ideals; his saving grace of humor; his active sympathy with all aspiring youth; his philosophic grasp of the one essential, truth, as a basis for all philosophy of action; all these traits explain his achievement as "naturalist, teacher and minor prophet of democracy." He has been great in all these characters.

The story of his highly successful development, in the face of seemingly insuperable obstacles, of Stanford University; of his contributions to internationalism by his services as official representative of the United States in connection with the solution of the fur seal problem and as unofficial but powerful representative of this country on many visits to Japan, Australia, and Europe; his consistent struggle against the Gods of War through a period where these Gods had their way with mankind; the stories of all these are illuminatingly told in the "Days of a Man." They are all inspiring; they all point the way toward human advancement; they all make one eager to go and try to do likewise. The "Days of a Man" is a good book for youth to read, and a good book for men and women, eager to help in the progress of humanity but occasionally discouraged by their hard contacts with the inertia and sordidness of much of our governmental and educational politics, to have conveniently at hand from which to draw new encouragement and determination.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL
WASHINGTON, D. C.

SPECIAL ARTICLES

USE OF THE CARBON DIOXIDE FREEZING ATTACHMENT ON THE ROTARY MICROTOME

SEVERAL years ago in the *Botanical Gazette* (Vol. 63, pages 236-239, 1917) Professor N. L. Gardner described a method for securing sections of various plant objects easily, quickly, and in large numbers by means of a brine-cooled microtome stage mounted on a rotary microtome. This apparatus has proven particularly useful in preparing sections of fresh leaves, or other living plant objects containing little woody tissue, for study by students in general botany. When sections prepared by this method are examined within an hour or two of cutting, the cells show no evidence of injury from the short exposure to low temperature. They appear to be in all respects equal to fresh free hand sections and are superior in that they are complete and much thinner than those usually secured by hand sectioning.

There are two serious disadvantages, however, in using this method in preparing sections for a large class. First, the preparation of the ice, its mixture with salt, and the charging of the containers which deliver the brine to the freezing chamber are rather arduous and time consuming tasks and second, if laboratory classes are spread over four or five days each week it is necessary either to charge the apparatus with ice and salt on several occasions in order that fresh sections may always be available or to use sections which have been cut for several days. Such sections are entirely unsatisfactory even if kept on ice.

It had occurred to the writer that, in place of the brine freezing attachment, a carbon dioxide freezing attachment might be connected to a rotary microtome and that thus both of the disadvantages mentioned might be avoided. The only objection which presented itself was that the short metal tube of the carbon dioxide attachments furnished by the dealers in microtomes might prove so rigid as to interfere with the free movement of the microtome stage on the rotary microtome and thus cause considerable irregularity in the thickness of the sections and perhaps injure the microtome. To avoid this the tube of a Spencer Carbon Dioxide Freezing Attachment was separated from the threaded connections for the CO_2 tank and microtome stage, and in its place was brazed a ten-foot length of one quarter inch, a one thirty-secondth inch wall copper tube such as may be secured for a small sum from any dealer in automobile garage supplies. The greater length of this copper tube and its somewhat greater flexibility permitted such freedom of movement of the freezing chamber that the latter could be safely attached to the rotary microtome and sections of uniform thickness could be secured. This application of carbon dioxide freezing to the rotary microtome has proved entirely satisfactory and much more economical than brine freezing except where cutting is to be continued without interruption over a period of three or four hours.

With the rotary microtome and CO_2 freezing attachment set up in the preparation room adjoining the elementary laboratories it is now possible for an assistant within five or ten minutes to prepare the material, freeze it, and cut enough sections for several hundred students. With very little expenditure of time and energy fresh sections can be provided for all laboratory classes.

The material is frozen in a small quantity of relatively thick gum arabic solution. The temperature which must be used to convert this mucilage into a firm supporting mass is apparently not sufficiently low to cause visible injury to living plant tissues by freezing.

A feature which adds much to the convenience of the method is the use of a small wooden block, described in Professor Gardner's article. This block is so cut away on one side as to form with the microtome knife to which it is fastened by means of a wire clamp, a chamber into which the sections fall as they are cut from the frozen mucilage mass. The chamber is partly filled with water, the contact of the block with the knife is made water tight by means of a thin layer of vaseline. When cutting is completed the sections may be easily poured from the chamber with the water.

It is perhaps not superfluous to add that sections thus cut are given to the student for study only after he has cut and examined free hand sections of the same material.

Richard Holman

University of California

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and twenty-seventh regular meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, February 24, extending through the usual morning and afternoon sessions. The attendance included thirty-five members of the society.

The secretary announced the election of twenty-six persons to membership, and the entrance into the society since the annual meeting of seven additional members of the London Mathematical Society under the reciprocity agreement.

At the meeting of the council, the secretary announced the appointment by President Veblen of a committee on endowment, with Professor J. L. Coolidge as chairman. A committee on arrangements for the summer meeting at Vassar College was appointed consisting of Professors H. S. White *(chairman)*, G. M. Conwell, E. B. Cowley and L. D. Cummings and the secretary. Professor E. V. Huntington was appointed representative of the society in the Division of Physical Sciences of the National Research Council for the period of three years beginning July 1, 1923.

The following papers were read before the society at this meeting:

Circular plates of constant or variable thickness: C. A. Garabedian.

Permutable rational functions: J. F. Ritt.

The maximum number of cusps of a space curve: T. R. Hollcroft.

Theory of the octavic: A. M. Whelan.

Analogy between electromagnetic field and analytic function: G. Y. Rainich.

The existence of closed geodesics on surfaces. Preliminary communication: J. W. Alexander.

The asymptotic expansion of the functions $W_{k,m}(z)$ *of Whittaker:* F. H. Murray.

Some geometric applications of symmetric substitution groups: A. Emch.

A property of Haar's system of orthogonal functions: J. L. Walsh.

The Riemann adjoints of certain completely integrable systems: C. A. Nelson.

Intermediate curvatures in Riemann space: E. Kasner.

Concerning the common boundary of two or more regions: G. A. Pfeiffer.

Some theorems on insolvable groups: L. Weisner.

Values in terms of Bernoulli and Eulerian numbers: I. J. Schwatt.

On the reduction of differential parameters in terms of finite sets. Preliminary report: O. E. Glenn.

A new form of Stirling's interpolation formula: G. Rutledge.

On the angle between two curves in V_n: J. Lipka.

On the accessibility of the boundary of a domain: R. L. Wilder.

Determinantal relations based on a matrix whose elements fall into two classes: L. H. Rice.

Maximum modulus of some expressions of limited analytic functions: S. Kakeya.

The society will meet at the University of Chicago April 13-14 and at Columbia University April 28.

R. G. D. Richardson,
Secretary

SCIENCE

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RESEARCH IN THE MEDICAL SCIENCES[1]

The medical sciences may be defined as including those secondary sciences which contribute directly or indirectly to preventive and curative medicine and to public health. In common with other sciences the medical sciences have both theoretical and applied aspects, and research is the underlying principle of all knowledge and advance in both. Research and theory are interdependent, theory underlies practice, and practice at its best continues to utilize and to stimulate and accomplish research. Research after all simply reflects a state of mind; that state of mind that is not satisfied with the acceptance and application of an alleged group of facts but that insists on personal verification and extension thereof. This questioning and itching type of mind is in its highest reaches inborn, but its cultivation is not only possible in normally equipped individuals, but would seem essential for the proper fulfillment of a life on the level of a profession.

THE FIELD

The medical sciences afford fields of research which yield results comparable to those that accrue from the other sciences—happiness through intellectual gratification, opportunity for human service and a livelihood. It is true that the secondary sciences that are grouped as medical are less exact than the older fundamental sciences in the sense that they are younger, less fully formulated and more complex. The last feature alone suffices to assure an even wider range of intellectual gratification than do those sciences that enjoy greater technical accuracy. To many the prolongation of life and the mitigation and prevention of physical suffering is the highest form of human service. A livelihood is now assured even to the teacher and investigator of medical theory. It is a matter of pride to medical scientists that discoveries in their field which are frequently of the most far reaching human importance can never, from the ethics of the profession, be utilized for personal pecuniary gain. If one is drawn to the more practical aspects of applied medicine, whether in the laboratory or at the bedside, an often generous, though seldom large, financial return is possible, coupled with opportunity for great and personal human service. Investigation may still continue under these latter conditions, although it is less likely to flourish.

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[1] This article is one of a series on "Opportunities for a career in science" that is being prepared for the Division of Educational Relations of the National Research Council.

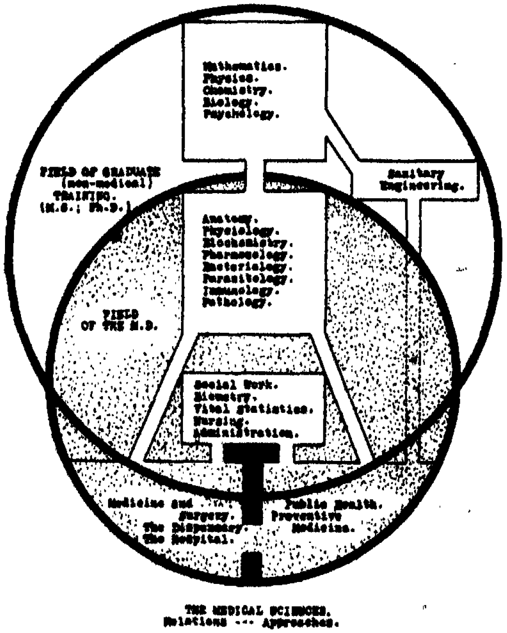
THE RELATION OF THE MEDICAL SCIENCES TO THE PRACTICE OF MEDICINE

There is still a common misapprehension that the medical sciences are formulated and advanced entirely or for the most part by practitioners of medicine. In the middle ages physicians began to be dissatisfied with the explanations of the structure and function of the human body and of the nature of disease that had been handed down from Galen and Hippocrates. Certain radicals like Paracelsus began to ask themselves questions about these matters, to review the evidence in person, and to arrive at conclusions by a process of reasoning. Ratiocination in turn gave way to the methods of direct observation, and finally certain fundamental truths, as, for example, the circulation of the blood (Harvey) came to be worked out not by taking advantage of chance occurrence in the sick or well, but by deliberately planned experiments on living animals. The physician still remains the one most concerned in knowing the natural conditions of structure and function in the animal body, and particularly such modifications of them as occur in disease. Each year the physician has behind him a greater body of determined facts which enable him to understand and to modify the processes which he sees going on in his patients. Indeed, the body of facts on which his expert skill rests has become so great that his life becomes a frantic attempt to keep up with those advances which he may utilize advantageously in the treatment of disease. The increase of specialization in medicine means simply that the physician has realized that to be most effective he must focus his attention on certain types of disease or on certain localizations of disease in the body. The practitioner still sees best the gaps in present knowledge that, if filled, would enable him to understand and to counteract those manifestations of disease by which he is confronted. But the filling of these gaps with those new facts on the basis of which the practitioner acts has often been and is increasingly becoming a function of yet other groups of specialists whose interests lie in the impersonal study of animal structure and function in health and disease, apart from any practical application that may follow such information. It requires a lifetime of endeavor to acquire the technique requisite for the modern investigation of a new problem, let us say, in the normal or vitiated chemistry of the human body. This means that increasing numbers of anatomists, physiologists, biochemists, bacteriologists, parasitologists, immunologists, pathologists and others have come into being, whose daily life is occupied not with the care of the sick but with the study of conditions underlying such care. This specialization in each of the numerous medical sciences is merely a further manifestation of the advantageous division of labor.

THE TRAINING OF MEDICAL RESEARCH WORKERS

Workers in these underlying and more theoretical fields of medicine are engaged in increasing numbers not alone in eliciting new facts of eventual value in the progress to medicine but in carrying out for practitioners those diagnostic procedures which their particular branch of science has developed. The career of these workers in the laboratory sciences, therefore, include not only research and teaching but routine practice. The question now arises as to how those who choose careers in the medical sciences are actually being trained for their work and, indeed, what method of training is the best. The profession of medicine is at least moderately endowed with guild consciousness. The physician has at times been somewhat disturbed to find that the problems on the solution of which his art depends are being solved by those who have failed to follow in his footsteps through a course in medicine and through contact with the sick. The physicians of France at first vigorously resented the fact that Pasteur, a mere chemist, offered certain indisputable proofs of the parasitic nature of the infectious diseases in man and animals. Even Koch, who with Pasteur founded the modern sciences of bacteriology, and himself a practitioner of medicine, made vigorous strictures on Pasteur's claim to have succeeded in preventing splenic fever (anthrax) in cattle, in view of the latter's lack of training in comparative pathology and veterinary medicine. But, fortunately, advance in science is not dependent on a pattern of training. The prepared and particular mind at work on a given problem remains the essential element in its solution. The chemist continues to be the man best fitted to attack a problem of chemistry, whether that particular problem in chemistry relates to structure of the atom or the metabolism of the diseased human body. A physician may, to be sure, be somewhat of a chemist, but it has become increasingly more difficult for one to remain an essential contributor in several scientific fields.

An attempt is made in the accompanying diagram to show the relations of the fundamental sciences of curative and preventive medicine and of public health to the medical sciences. The two enclosing circles show the respective fields for which graduate training as exemplified in higher degrees fits a prospective student. The difference in size of the circles is designed to indicate the fact that there are actually more scientific subjects of direct or indirect value to medicine for which a Ph. D. degree can and does fit a student than does the regulation medical training. Even in the practical fields of curative and preventive medicine the non-medical graduate is gradually bearing more and more of the burden, here subordinate, to be sure, to the predominating care of the sick.



THE MEDICAL SCIENCES.
Relations --- Approaches.

To be concrete, the Doctor of Philosophy in the appropriate field may be and actually does become the Professor of Anatomy, Physiology, Biochemistry, Bacteriology, Pharmacology and probably in the near future Pathology. It is needless to say that he makes contributions to each of these subjects and even with less advanced training (M. S.). In the practical fields we have, in addition to non-medical social workers, statisticians and nurses, non-medical administrators of hospital and public health enterprises, at least in lesser positions. No one would dream of looking for a sanitary engineer among medical graduates, and even non-medical epidemiologists have been utilized.

This growing importance of non-medical scientists in more or less purely medical subjects is in part due to the law of supply and demand. Doctors of Medicine are too few, their training too long and expensive, to expect that many of them will fill the less remunerative positions which theory affords as compared with practice. And apart from pecuniary regard, the personal human touch, the joy of direct human service which fortunately appeals to the majority of mankind, leads most graduates in medicine into the practical field. And, then, it must be confessed that in some respects the non-medically trained man is often better fitted both as a teacher and investigator than the medical graduate to forward the medical sciences.

To be specific, what course would we lay out for a recent graduate of a university (A. B.) who had taken a course in general bacteriology in his sophomore year, had later been permitted to take the regular course in medical bacteriology and who now plans to make bacteriology in its medical aspects his life's work? Should he proceed through the regular medical course for a period of five years to the medical degree, or should he proceed through a shorter period of from three to four years to the Ph. D. in Bacteriology? If he is so advised and follows the first plan he will on graduation in medicine, and after a required interne service in medicine and surgery, have a general idea of human disease problems and the general relations of bacteriology to them; he will thereafter, however theoretical he may become, be able to stand unabashed in the presence of a patient and discuss symptoms with his clinical colleague, but he will be but little better as a bacteriologist than he was four years before, and, unfortunately for his first love, he will in all probability have long since ceased to wish to become one. As a successful Ph. D. on the other hand, our student will have demonstrated two years earlier his ability as an independent research worker in bacteriology, he will have made the first steps in a teaching career and he will have added something to the sum of human knowledge in his field. For better or worse the latter man is a recruit to the science he has chosen, but from the personal standpoint he is a recruit with a handicap in the eyes of his henceforth medical colleagues which he can live down only by superior ability. Such choices must after all remain for the individual to make and should and will be made in the light of what he insists on doing. At least it should be clear that a research career in the medical sciences is open both to medical and non-medical graduates.

OPPORTUNITIES FOR RESEARCH

The opportunities for these research careers in medical science are now present in many places, admixed with more or less responsibilities of a more defined or routine sort, as teaching, which is a stimulus to research, diagnosis, which by the clever mind in its most routine forms takes an investigative trend, and administrative duties. Research institutions exist for the pure investigation of any or of some particular medical problem. The universities, fortunately for their teaching, remain the fostering places of pure research while affording the constant human stimulus of contact with fresh young minds. Public health laboratories, municipal, state and federal, while largely administrative in function, always under wise guidance, afford research opportunities and, indeed, present the latest, most urgent, and, frequently, most interesting problems. Even hospital laboratories with predominating routine duties are recognizing the need of including research possibilities in order to secure a really competent personnel.

Repetition of a procedure that has been mastered is the path of least resistance, and when followed by more and more flattering administrative responsibilities with opportunity for human contact, leads in the career of many to a languishing of research. Research is recognized as a stepping stone to preferment and is frequently utilized for this purpose alone; something is accomplished even in this way to the benefit of the individual and the science. The greatest investigators are probably seldom lost in spite of difficulties that are put in their way and the seductive paths that lure them, but the rank and file of minor contributors is essential. A determination to start a career which shall include research and opportunity for its accomplishment do not suffice. An encouraging and never-failing belief in the essential necessity for research, a scholarly atmosphere, should surround the majority of beginners. Such an atmosphere usually occurs in the universities and in research institutions and only occasionally elsewhere.

FREDERICK P. GAY,
Chairman

DIVISION OF MEDICAL SCIENCES,
NATIONAL RESEARCH COUNCIL

"THE FRIENDLY ARCTIC"

THERE appeared in SCIENCE for July 7, 1922, an article by Diamond Jenness, entitled "The Friendly Arctic." In this article Mr. Jenness is spokesman for those members of one of the subdivisions of my 1913-1918 expedition who caused the disturbance which in newspaper controversy has since come to be known as "the Collinson Point Mutiny" and which is described in Chapter XIII of my book, "The Friendly Arctic." I am informed that a reply to Mr. Jenness will be published in SCIENCE by two of the loyal members of the expedition, Burt M. McConnell, now one of the editors of the *Literary Digest*, and Harold Noice, who is now in New York working up the results of his six years in the polar regions, two years as member of my expedition and four years conducting his own expedition in Coronation Gulf.

I have heretofore refused to reply to any newspaper attacks, preferring to rest my case on the vote of thanks of the Canadian government, the preface to my book written by the prime minister of Canada, and on the action of the Explorers Club of New York, the American Geographical Society, the National Geographic Society and the Minister of Mines of Canada, to all of whom the charges made by Mr. Jenness have been submitted together with numerous other charges. The replies were as follows: After consideration of the charges, the Explorers Club elected me to its presidency; the American Geographical Society gave me their Daly Medal; the National Geographic Society awarded the Grant Squires prize to "The Friendly Arctic"; the prime minister of Canada moved a vote of thanks which was passed on January 21, 1921 (nearly seven years after the charges against me were first circulated at Ottawa); and the minister of mines (the head of the department in which Mr. Jenness is employed) declined to investigate written charges submitted by Mr. Jenness and four or five of the men who had been in the section of the expedition that disobeyed instructions.

Since these attacks continue in spite of official action by scientific bodies and by the Canadian government, I shall now take notice of them to the extent of publishing in the appendix to the next edition of "The Friendly Arctic" the charges submitted to the various scientific institutions and to the Canadian government together with the full text of the documents showing the action of these societies. I shall also publish the full text of the orders of the expedition from which Mr. Jenness has made the garbled quotations published in SCIENCE for July 7, 1922.

Mr. Jenness attacks Dr. Pearl on two general grounds—his incapacity to judge of a work on polar exploration, and his ignorance of government documents other than those published in "The Friendly Arctic." Dr. Pearl's standing as one of the leading scientific men of the United States is too well known to readers of SCIENCE to need comment here. As to familiarity with polar conditions, Dr. Pearl himself states his case so clearly in the review that further comment is superfluous. But as to his alleged unfamiliarity with the documents of the expedition, I can say something here that may enlighten Mr. Jenness and interest any one who wants to form an opinion on this case. It happened that Dr. Pearl spent the summer of 1920 within half a mile of the place where I was engaged upon the final revision of "The Friendly Arctic." During that summer and previously, I had an extensive correspondence with Sir Robert Borden, who had been prime minister of Canada during the entire course of my expedition. Although the correspondence was not intended for publication, it was not so private that it might not be shown to my intimate friends. Dr. Pearl, therefore, saw the parts of the manuscript dealing with the Collinson Point mutiny, which had been read by the prime minister himself, and he saw the prime minister's signed comments on this part and the signed text of the preface which the prime minister wrote for "The Friendly Arctic." Instead of being, as Mr. Jenness alleges, unaware of the disapproval of my work by the Canadian government, he was, as a matter of fact, aware of the approval of that work by the Canadian government—for surely the written approval of the prime minister who was in charge during the entire expedition is the approval of the government. If employes of the government, such as Mr. Jenness, dissent, they do so on personal or scientific grounds and without any right to speak for the government which employs them.

VILHJALMUR STEFANSSON

In SCIENCE for July 7, 1922, there appeared an article by Diamond Jenness under the title, "The Friendly Arctic." It was ostensibly an attack upon Dr. Raymond Pearl and his review of "The Friendly Arctic" (in SCIENCE for March 24, 1922), but really an attack upon the book of that title and upon its author, Vilhjalmur Stefansson, the commander of the Canadian Arctic Expedition of 1913-1918. To any one who has read the book carefully or who knows either Pearl or Stefansson the Jenness attack will seem to need no reply. So at least it seemed to the writers of this article. But it now appears that many readers of

SCIENCE are really accepting the Jenness attack as (1) fair, (2) truthful and (3) reflecting the attitude of the government at Ottawa. Accordingly we have decided to reply to it under those three heads.

First, the parties to the dispute should be introduced.

Diamond Jenness was attached to that subdivision of the Canadian Arctic Expedition which "mutinied" against Stefansson's command. This "mutiny" is fully, fairly and (we think) too leniently described in "The Friendly Arctic." Jenness was absent when the "Collinson Point Mutiny" actually took place and did not see Stefansson after that (March, 1914) at any time during the remaining four years of the expedition. He heard about the "mutiny," therefore, only from those who had opposed Stefansson—presumably a colored view.

Burt McConnell and Harold Noice both belong to the part of the expedition that was faithful to the commander and that helped him carry out the work which Jenness criticizes. Having been loyal to the expedition and faithful in our duties, we now defend Stefansson quite as logically as Jenness attacks him.

McConnell was Stefansson's secretary from the time the expedition assembled in 1913 until about a month after the "mutiny," and took part in the early stages of the 1914 ice journey (the one which the Dr. Anderson faction—now defended by Jenness—tried to prevent Stefansson's making; the one on which he was given up as dead for a year by the expedition and the world in general, except a few, including McConnell). The lady who is now Mrs. McConnell had been Stefansson's secretary during the organization of the expedition. McConnell is, in some respects, as well informed, therefore, as Stefansson himself on incidents which occurred in Victoria and Nome months before and which led indirectly to the "mutiny." He also knows what happened then at Collinson Point and just thereafter.

Harold Noice accompanied Stefansson on two of his longest ice journeys—those of 1915 and 1916. He is therefore qualified to say whether Stefansson describes correctly in "The Friendly Arctic" his method of "living off the country" and whether it is Jenness (in SCIENCE for July 7, 1922) or Pearl (in SCIENCE for March 24, 1922) who misunderstands and misrepresents Stefansson's deeds and views.

Of the three issues raised by Jenness we shall consider first whether he expresses or represents the position taken by the Canadian government. Jenness seeks to have the reader make that inference by heading his article with "Published by permission of the Deputy Minister of Mines." Those familiar with government routine will know, however, that this does not signify that the Deputy Minister is for or against Stefansson, or has taken sides at all. It merely shows he gave Jenness (an employee of his deparment) such permission to publish as Stefansson himself, Storkerson and other members of the expedition frequently sought and received from their respective superiors while they were in government service.

That the Canadian government has permitted Storkerson (who is for Stefansson) and Jenness (who is against Stefansson) both to publish shows nothing but a liberal attitude in permitting free speech. But the government has other ways of recording its position and has done so very decisively.

Canada had two prime ministers during Stefansson's service. Sir Robert Borden was premier while the expedition was in the field, and Mr. Arthur Meighen when "The Friendly Arctic" was published. Sir Robert read the entire manuscript of "The Friendly Arctic" before it went to press, and the part dealing with the "mutiny" he read over again in galley proof before he wrote the preface. He knew what the rumors being circulated by the "mutineers" were. If the reader will turn to Sir Robert's preface he will find that those rumors are answered by the premier, though he does not mention them. It is apparent that no endorsement by a government could be stronger than that which the (at that time) premier of Canada gave to Stefansson in his preface to "The Friendly Arctic."

But the rumors against Stefansson continued being industriously circulated at Ottawa, where Dr. Anderson, Mr. Jenness and other members of the expedition reside. It was perhaps as much to set them at rest as to show the government's gratitude for important work well done that the next premier of Canada, Mr.

Meighen, moved a vote of thanks of the Canadian nation on January 21, 1921. At the end of a long and laudatory summary of Stefansson's work, the document closes:

> The committee, on the recommendation of the Right Honourable the Prime Minister, and in view of these considerations, advise that in recognition and appreciation of his distinguished services the thanks of the government of Canada be formally extended to Mr. Stefansson.

Sir Robert Borden's endorsement of Stefansson is available in any library as the preface to "The Friendly Arctic"; a copy of the vote of thanks can probably be secured free by any one who writes to the Undersecretary of State at Ottawa asking for Privy Council Document No. 2887 for January 21, 1921; an article by Jenness implying that Stefansson disobeyed government instructions, mismanaged the expedition, and is not endorsed by the government of Canada is available in the files of SCIENCE under date of July 7, 1922. It might be interesting to read and compare the three documents and then decide whether Jenness speaks for the government or whether its two premiers do.

Under the heading of whether Jenness is fair in his SCIENCE article we might ask the reader to check up on his quotations from Stefansson's writings and decide whether he does not in many cases select them so as to convey the opposite meaning of that intended by Stefansson. Take, for instance, the insinuation that Stefansson claims to have originated the method of living off the country and Jenness' citation of Rae as having done so long before. But in his "My life with the Eskimo" (pp. 304-305)), published in 1913, Stefansson says clearly that Rae lived by hunting, and praises him as a pioneer. Jenness, therefore, merely corroborates what Stefansson had said nine years earlier, although the general tenor of his article would lead the uninformed to believe he is disproving something Stefansson has asserted.

The most fundamental unfairness of the Jenness article to Pearl and Stefansson is that he very cleverly confuses one exploring method borrowed and improved upon with another which Stefansson originated, and tries to show he originated nothing by giving one name to two very different things. Stefansson's agreement with certain authorities on the one head and his disagreement with all authorities on the other is so clearly stated in Chapter XIII of "The Friendly Arctic" that no one can misunderstand. Stefansson had used for four years, with success, Rae's method and that of the Eskimos of hunting on or near land. But neither Eskimos, arctic whaling captains, explorers, nor geographers believed he would find sufficient animal life hundreds of miles from land in the Beaufort Sea to use there a similar method. This was the central issue upon which the "Collinson Point Mutiny" against Stefansson was based, and the chief reason why Stefansson was later given up for dead. When the insubordinate members of the expedition had failed to prevent his starting out on the sea ice with a plan of living a year by hunting, the story of his death arose because he did not return inside three months, for it did not seem to any but a small minority of his friends that there was any chance of his having found game to live on.

Jenness tries to confuse the reader with thinking there was and is a dispute as to who originated the method of living by hunting *on or near land*. That was invented by northern aborigines in prehistoric times. But few things called new are really more new than Stefansson's triumphantly established theory that sufficient game could be found under and on the ice *far from land*.

Jenness, with much subtlety, tries to show that Pearl and Stefansson contradict each other, and that Stefansson contradicts himself as to whether he really relied on the method of living by forage. Any one who looks up the quotations and reads both them and their context will see there is no such contradiction. For instance, Jenness quotes Stefansson: "Our own grub will be chiefly rice, fat and sugar," and apparently wants the reader to infer that Stefansson was talking about a whole journey. Any reader of "The Friendly Arctic" knows better, and especially we who were with him know better. He was talking about the food with which we always filled our sleds on starting from a ship. This we ate as fast as we felt like until it was gone, for we had full confidence in getting game after the sun came back. The food we hauled was merely to enable us to get well started on our long journey in the early spring before there was as yet enough hunting light.

Take another instance: "Mr. Stefansson * * * wisely provided himself with three vessels loaded with all necessary supplies of pemmican, sugar, rice and other foods," says Jenness, but he neglects to point out that those ships were hundreds and sometimes a thousand miles away from where we were traveling and living by hunting, and that they were largely occupied in supplying not Stefansson but Jenness and his associates. Some of the ships were carried off in Stefansson's absence (when he was thought dead) by the Anderson-Jenness faction and against Stefansson's written orders. Furthermore, all members of the Stefansson expedition know that most of the supplies carried on these ships were originally provided to feed their crews and those members of the scientific staff who operated near a ship base—not Stefansson and his exploratory parties, who lived by hunting far away and used the ship supplies only when they were near the ships and when it happened to be less bother to do so than to hunt.

It takes too much space to trace all the adroit misquotations of the Jenness attack. Those who have the inclination can do so in "The Friendly Arctic," "My Life with the Eskimo," and Stefansson's other books.

We now go on to a consideration of whether the Jenness paper does not pass over the borderline of being merely adroitly unfair and misleading into the domain of simple untruthfulness.

There was one part of the Jenness paper that astounded us. With all our knowledge of the extent to which misrepresentation has been carried in trying to gloss over the circumstances relating to the "Collinson Point Mutiny," we did not think Jenness or any one else would dare to misquote government documents, especially those written by men still living. Accordingly, we were dumbfounded by the section of the Jenness article (p. 9 of the SCIENCE article) which purports to quote instructions given by the Honorable G. J. Desbarats, Deputy Minister of Naval Service (who, by the order-in-council which governed the expedition, was in charge of it on behalf of the government) to the effect that Stefansson was not in full command of the expedition. We thought, for a moment, that these were some instructions hitherto not published. That seemed unreasonable. Mr. Stefansson, being himself unable to understand the basis for Jenness's statement, wrote Mr. Desbarats submitting with his letter a copy of the Jenness article from SCIENCE. Mr. Desbarats' reply to Mr. Stefansson we are permitted to quote. It is as follows:

Deputy Minister's Office
Ottawa
1st August, 1922.

I am in receipt of your letter of the 29th enclosing a clipping from SCIENCE which contains a letter from Mr. Jenness regarding your book, "The Friendly Arctic."

On reading the quotation from the official orders beginning at the foot of page 9, I was extremely surprised at the idea of my having written anything of the kind. On comparing the quotation with the text of the instructions I find, however, that the quotation is correct, *only it is made up of three different paragraphs which in the original are separated by pages of instructions. The sentences quoted, when gathered together, as they are in Jenness's letter, give a different impression to that which they were intended to convey, or did convey when read together with the rest of the instructions.*

There can be no doubt of the government's intention to appoint you in command of the Canadian Arctic Expedition. The order in council authorizing the expedition states "Mr. Stefansson to have full responsibility, and to have the choice of the men going on the expedition and of the ship, provisions and outfit needed for the trip."

The instructions which I issued to you and from which Mr. Jenness takes his quotations are equally clear. They state, "The expedition will be under your personal direction and control, and you will give general directions to the various leaders of parties, as may be required."

The instructions which I sent out were always addressed to you. Instructions to Dr. Anderson were given to him only in your absence on your long exploring trip.

(*Signed*) G. J. DESBARATS,
Deputy Minister of Naval Service

Disobedience of orders on a polar expedition is as serious a thing as disobedience in time of war. In both cases men's very lives depend on the loyalty and discipline of their companions. It is easily understood, therefore, that those who disobeyed will leave no stone unturned in attempting justification or extenuation. It is difficult to see, however, why they keep nagging until they drive into breaking silence us who know disagreeable things about them which Stefansson has left untold. But they at least have courage—to write from Ottawa misquotations of Ottawa officials and to assert (in the face of a vote of thanks from the Canadian nation and the endorsement of two prime ministers) that Stefansson did not have the support and does not now command the confidence of the Canadian government.

Of course the two premiers named are no longer in office and a new government has taken their place. Thinking, apparently, they might have better success with the new officials the Anderson-Jenness faction of the expedition lodged with the Minister of Mines in March, 1922, certain charges against Stefansson. These were dismissed by the minister, showing that the attitude of the present government does not differ from that of the preceding.

There remain to be mentioned Mr. Jenness's insinuations that Dr. Pearl is ignorant of Arctic conditions. Mr. Jenness can hardly say the same of us (Noice, at least, has been in the Arctic six years against three for Mr. Jenness). It is curious, then, that we find ourselves so uniformly in agreement with Dr. Pearl. Of course, Mr. Jenness may explain this by our well-known loyalty to Stefansson and our support of him and his views. But we can similarly explain the Jenness attack by his well-known affiliation with the men who in 1914 disobeyed Stefansson's orders on the ground that his views were so wrong and his plans so "unsound" that he was practically "crazy," and that they were therefore "justified" in their disobedience.

Now that the views they then thought crazy have been tested and found sound, now that the methods so bitterly criticized have been proved successful, would it not be better both for those who supported Stefansson and those who opposed him to stop squabbling and turn to more constructive things?

BURT M. MCCONNELL
HAROLD NOICE

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

To the series of research fellowships in physics, chemistry and medicine now being maintained by the National Research Council, with the financial support of the Rockefeller Foundation and the General Education Board, a new series in the biological sciences has just been added. This new series is made possible by a gift of $325,000 from the Rockefeller Foundation to be expended during the five-year period, July 1, 1923-June 30, 1928. This makes a total sum of $1,325,000 to be used by the council in the maintenance of post-doctorate research fellowships in the various scientific fields already noted.

The new series of fellowships in the biological sciences (including zoology, botany, anthropology and psychology) will be awarded to persons who have demonstrated a high order of ability, for the purpose of enabling them to continue research at suitable institutions, preferably in the United States. The personnel, equipment and presumptive cooperation of institutions will be considered in determining the residence of the fellows.

Purposes. The purpose of the National Research Fellowships in the Biological Sciences is the promotion of fundamental research in these subjects. This involves not only the immediate acquisition of more knowledge through research, but also the securing of a greater number of thoroughly trained investigators. It is hoped that the establishment of such fellowships may prevent the loss of research interest in the early post-doctorate years by the premature or excessive absorption of promising investigators in teaching, and may also improve the conditions for research in the educational and other scientific institutions of this country.

The term educational or scientific institutions, as herein used, is not to be interpreted as referring exclusively to colleges, universities and technical schools, but may include such institutions as marine or fresh-water stations, museums, government bureaus or special research institutes.

Stipends. Fellowship stipends are not intended to compete with the salaries of teaching and industrial positions. They are calculated to provide comfortable living conditions for exceptional research students. They will be adjusted to family responsibilities, individual circumstances and needs. The basic stipend for first appointments will be $1,800. Appointments of fellows are for twelve months and may be made at any time but usually so as to coincide with the beginning of the academic year.

Fellowship Regulations. Fellows are expected to devote their entire time to research, except that during the college year they may, by written permission of the board, give a portion of their time, in general not more than one fifth (outside preparation included), to teaching of educational value to themselves, or to attendance on advanced courses of study. They may associate graduate students with their researches. They shall not engage in work for remuneration during the term of their appointment.

Fellows are expected to submit to the board shortly before March 1 of each year a detailed report, in duplicate, on the progress of their work. They must also present an account of their research in form as for publication before termination of the fellowship. It is understood that all results of investigation by the fellows shall be made available to the public without restriction.

The publications by a fellow of the results of the investigations carried on during the tenure of his fellowship must include a suitable acknowledgment. When such publications appear the author is expected to furnish twelve copies of each paper to the secretary of the board of fellowships in the biological sciences, National Research Council, Washington, D. C.

Appointments are subject to the condition that when a fellowship has been accepted by the applicant, it will not be vacated within the year without consent of the board.

Applications. Each application for a research fellowship in the biological sciences will be considered individually on its merits. Especial attention will be given to the probability of meeting the purposes for which the fellowships were established.

Fellows will be appointed for one year, but they may be reappointed at increased stipends.

Applications must supply evidence of their research capacity, training and intentions. This will usually include the following items:

1. A doctor's thesis or its equivalent.
2. Reports of other research work in printed or manuscript form.
3. (*a*) Academic and personal record; (*b*) an outline of the proposed research program, including the institution at which it is planned to work. These items should be presented on blanks which are provided by the secretary of the board.

In addition to the foregoing, endorsements of responsible scientists, including estimates of the applicant's qualifications, will be required. These communications should be sent directly by the writers to the secretary of the board of fellowships in the biological sciences, National Research Council, Washington, D. C.

Cooperation of Institutions. It is anticipated that institutions at which fellows are received will waive fees and will extend the usual facilities and services accorded other research workers.

Administration. The special funds for National Research Fellowships in the Biological Sciences will be administered by a board appointed by the National Research Council. The board, as at present constituted, consists of the following persons:

Frank R. Lillie (chairman), professor of zoology, University of Chicago, and chairman, Division of Biology and Agriculture, National Research Council; H. H. Bartlett, professor of botany, University of Michigan; Raymond Dodge, professor of psychology, Wesleyan University, and chairman, Division of Anthropology and Psychology, National Research Council; C. E. McClung, professor of zoology, University of Pennsylvania; T. H. Morgan, professor of experimental biology, Columbia University; W. J. V. Osterhout, professor of botany, Harvard University; C. E. Seashore, professor of psychology, University of Iowa; E. L. Thorndike, professor of educational psychology, Teachers College, Columbia University; and Clark Wissler, curator of anthropology, American Museum of Natural History.

The board is now ready to receive applications for these fellowships. All communications should be addressed to the Secretary, Board of Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

VERNON KELLOGG,
Permanent Secretary, N. R. C.
WASHINGTON, D. C.

SCIENTIFIC EVENTS

POPULATION OF THE UNITED STATES

THE population of the continental United States on January 1, 1923, was approximately 110,100,000, according to an estimate announced by the National Bureau of Economic Research. This showed an estimated gain of 4,500,000 since the 1920 government census.

These figures are necessarily preliminary, said the bureau, for the final census figures on births and deaths are incomplete after the end of 1920. Enough data is available, however, to show that since January 1, 1921, the rate of increase in population has been accelerated noticeably, the present rate approaching that of pre-war years.

This more rapid gain in population has been brought about partly by increase in net migration, but has been decidedly reinforced by a reduction in the death rate. At the present rate of growth the population at the 1930 census will reach 120,000,000.

The estimates by half years are as follows:

Year and Date:	Population
1920—January 1	*105,710,620
1920—July 1	†106,381,000
1921—January 1	†106,821,000
1921—July 1	‡107,785,000
1922—January 1	‡108,533,000
1922—July 1	‡109,184,000
1923—January 1	‡110,100,000

*Census figures.
†Final estimate by this bureau.
‡Preliminary estimate.

It is probable that the revisions to be made in all estimates, except that for January 1, 1923, will be relatively slight.

The census bureau has made its estimates of the population for the intercensal years on the assumption that the rate of growth is the same as in the preceding decade. This process, which is termed a straight line extrapolation, has mainly its simplicity to commend it, for, when applied, errors of considerable size gradually accumulate as changing conditions affect population growth. For example, the official method showed a population for January 1, 1920, nearly two millions greater than that given by the actual census count on that date.

The method of the National Bureau of Economic Research is also relatively simple. The number of births and deaths have been estimated for each half year and the increase of population due to excess of births over deaths has been calculated. This amount has been corrected by adding the excess of immigration over emigration for each half year. The population for June 30, 1910, has been estimated from a smooth curve, and figures have then been built up for each half year until the census of 1920.

The estimate thus arrived at for January 1, 1920, is in error by approximately half a million, or only about one fourth of the corresponding error from the official method. The census work of the bureau has been under Dr. Willford I. King, formerly assistant professor of political economy of the University of Wisconsin.

THE FAUNTHORPE INDIAN EXPEDITION

PRESIDENT HENRY FAIRFIELD OSBORN, of the American Museum of Natural History, received on March 21 a cablegram from Mr. A. H. Vernay, of the Faunthorpe Museum Expedition to India, announcing that he had been successful in securing two exceptionally fine rhinos, a male and female, through special permission from the Maharajah of Nepal, and that the party had also secured a pair of tigers and a bear. Thus far, however, efforts to secure specimens of the pink-headed duck have failed and Mr. Vernay believes this species to be extinct, although further efforts will be made.

President Osborn states that the acquisition of the rhinos is of the first importance, not only because these animals are rapidly disappearing, but also because the Indian rhino is the largest member of that family now in existence.

Mr. Vernay's decoded message states that great difficulty was experienced in reaching the hunting grounds and that success was possible only through the assistance rendered by the

Maharajah, who provided elephants and coolies for transport and all the supplies necessary.

The Faunthorpe Indian Expedition left the United States on the first of November, 1922, accompanied by Mr. John Jonas, a taxidermist from Colorado. The party included a motion picture operator and an ornithologist. They started on their first *shikari*, or hunt, in February. Letters received from Mr. Vernay and Colonel Faunthorpe last week state that they have also secured fine representative specimens of the swamp deer, including a stag whose horns measure thirty-nine inches from tip to tip, with twelve points. The party has completed the collection of material necessary for the cheetal, nilgai and swamp deer groups, together with an excellent collection of birds. Other animals secured by the expedition are specimens of the Malabar langur. Mr. Vernay writes that these animals are very common in Bopal State where his camp was located, and added that it was with great reluctance that he shot any of these members of the monkey family, because they made no attempt at defence or attack, but that while a number of them were feeding upon the vegetation about the camp, they would post sentries from among their number who would watch for their natural enemies, the tiger and leopard, and the sentry always proved an easy target.

On March 22, it was the intention of the party to leave for Mysore to secure specimens of bison and elephants. They are sparing no efforts to obtain for the American Museum of Natural History the finest series of Indian mammals extant. All the material secured by the expedition is a gift of Colonel Faunthorpe and Mr. Vernay to the American Museum of Natural History and to the city of New York, and will form further definite bonds to cement the friendly relations now existing between England and the United States.

THE EYESIGHT CONSERVATION COUNCIL OF AMERICA

L. W. WALLACE, executive secretary of the Federated American Engineering Societies, has been reelected president of the Eyesight Conservation Council of America, which with the cooperation of engineers and educational authorities is carrying on a campaign to eliminate economic and physical losses due to poor eyesight in the schools and factories. Defective vision as a source of industrial waste was revealed by the Hoover committee on elimination of waste in industry, of which Mr. Wallace was vice-chairman. The section on conservation of vision was one of the notable features of the waste report.

Additional surveys in factories and in schools have multiplied the evidence, it is stated, that 25,000,000 gainfully employed Americans are thus afflicted. Eliminating these conditions is becoming an increasingly important problem of engineering. Associated with Mr. Wallace as members of the board of directors and of the Board of Councillors of the Eyesight Conservation Council, according to the announcement of the election of officers for the coming year, are several prominent engineers, including:

Professor Joseph W. Roe, of New York University, president of the Society of Industrial Engineers; Dr. Morton G. Lloyd, chief of the safety section of the U. S. Bureau of Standards and vice-president of the American Society of Safety Engineers; G. E. Sanford, of West Lynn, Massachusetts, past-president of the American Society of Safety Engineers.

Professor F. C. Caldwell, of the department of electrical engineering, Ohio State University, who with Secretary of Labor James J. Davis is a recent addition to the governing bodies of the Eyesight Conservation Council, is engaged in important studies in illumination bearing upon the question of eye conservation. Engineering methods will be employed by the council in surveys which are to be conducted in schools and workshops. Guy A. Henry, of New York, has been reelected general director of the council and will actively direct the eye campaign from the council's national headquarters in New York City.

Officially associated with these engineers in the movement are prominent educators, among them Dr. Sidney E. Mezes, president of the College of the City of New York; Dr. Thomas D. Wood, Teachers College, Columbia University; Dr. John J. Tigert, U. S. Commissioner of Education; Dr. Charles H. Judd, director of the School of Education of the University of Chicago; Dr. Arthur L. Day, Washington, director of the geophysical laboratories of the Carnegie Institution; Dr. Allan J. McLaughlin, Washington, U. S. Public Health Service; Dr. W. S. Rankin, Raleigh, state health officer of North Carolina; Bailey B. Burritt, New York City, general director of the New York Association for Improving the Condition of the Poor; R. M. Little, Albany, director of the Bureau of Rehabilitation of the New York State Department of Education.

Individual industries, as a result of the publication of the waste report, are adopting eye conservation methods to promote efficiency among the workers.

CHARLESTON MEETING OF THE AMERICAN ASSOCIATION OF MUSEUMS

THE American Association of Museums is to hold its eighteenth annual meeting in Charleston, South Carolina, April 4 to 6, on the occasion of the one hundred and fiftieth anniversary of the founding of the first museum in America. Not alone is this meeting unique in that it marks an event of special interest, but also it is important through the fact that a campaign for the launching of a new nationwide museum movement will be announced at that time.

The institution whose one hundred fiftieth year of service is to be honored is the Charleston Museum founded in 1773. It was established by the Charles-Town Library Society, and after passing through the hands of the Library and Philosophical Society and of the State Medical College it was lodged in 1850 in the building of the College of Charleston under what was probably the first contract by which a museum received municipal subvention. The Charleston museum was incorporated in 1915 and now occupies its own building. The present director is Miss Laura M. Bragg.

The new museum movement, which is to make its first public appearance at Charleston, is the culmination of an effort which has extended over a number of years and which now seems about to come to fruition. A grant of $30,000 has been made to the association by one of the large educational foundations, contingent upon the raising of an additional $55,000. There is every indication that the necessary funds will shortly be in hand and it is expected that by autumn the first attempts will be made to solve some of the general problems which American museums face to-day.

An ambitious program has been drawn up for this new work, and it will be discussed and elaborated at the Charleston meeting. Of course, only a few of the more important projects will be undertaken during the next year or two, but the plan looks well into the future. The funds now being raised will serve as a nucleus of support for three years and by the end of that time it is believed that provisions will have been made for continuance of the work.

The business of the forthcoming Charleston meeting is not its only attraction, for the gathering will be royally entertained. Each afternoon during the three days of sessions is to be devoted to seeing Charleston and to becoming better acquainted with Charleston people. The first evening there will be a series of informal receptions in the old homes and the meeting will be followed by a week-end house-party on the South Santee River. From headquarters at the Santee Gun Club and The Wedge and Harietta plantations, trips will be made into the heron reserves and along the rice field canals.

LAURENCE VAIL COLEMAN
Secretary

COLLOID CHEMISTRY SYMPOSIUM

PRELIMINARY announcements concerning the National Symposium on Colloid Chemistry, to be held at the University of Wisconsin June 12th to 15th inclusive, have already appeared in these columns. Inasmuch as this is the first national symposium on this subject to be held in America, it is desired that the whole field be represented, as far as possible, and the program has been arranged with that end in view. With one or two exceptions the papers will be presented in person by the author and ample time will be afforded for discussions. The papers and discussions will be published in monograph form, according to present plans.

It is hoped that the chemists and others interested in colloids will avail themselves not only of the opportunity to hear the papers presented, but to get acquainted with others in this most interesting and rapidly developing field of science, as well.

It is expected that accommodations for all visitors can be secured at the University Club or the University Y. M. C. A., both of which are near the lake and adjoining the campus.

Following the Symposium Professor Svedberg will give a series of about thirty lectures on colloid chemistry in the summer school, which commences June 25th and closes August 4th. Research work will be continued under his direction during this period.

The final program will appear about June 1st.

For further information letters should be addressed to Professor J. H. Mathews, Chemistry Department, University of Wisconsin, Madison.

The tentative program for the symposium follows:

Alexander, J. "The Colloidal state in metals and alloys."

Bancroft, W. D. "Precipitation of sols by alcohol."

Bartell, F. E. "Some adsorption studies."

Bogue, R. H. "Conditions affecting the hydrolysis of collagen to gelatin."

Browne, F. L. "Thermochemistry of sulfur sols."

Burton, E. F. "General considerations of the forces determining the limiting size of the colloidal particle in any given solution."

Fischer, Martin. "On the theory of the lyophilic colloids."

Gortner, R. A. "The application of colloid chemistry to agricultural problems."

Holmes, H. N. "Gel formation."

Kahlenberg, L. "On the precipitation of colloidal metals by means of metals in the solid state."

Klein, D. "The colloid chemical problems in the manufacture of enzymic and animal glandular products."

Mathews, J. H., and *Rowland B. W.* "The thermochemistry of protein behavior."

Sheppard, S. E. "Dispersity of silver halides in relation to their photographic behavior."

Spear, E. B. "Colloidal properties of rubber and compound ingredients."

Svedberg, The. "Demonstrations of colloid chemistry technique."

Taylor, H. S. "The problem of adsorption from the standpoint of catalysis."

Weiser, H. B. "The formation of inorganic jellies."

Wilson, John A. "The swelling of protein jellies."

Wilson, Robert E. "Surface films as plastic solids."

Papers are expected from T. R. Briggs, C. W. J. Frazer, Jacques Loeb and W. A. Patrick.

SCIENTIFIC NOTES AND NEWS

THE spring meeting of the American Chemical Society opens at New Haven on April 2, under the presidency of Professor E. C. Franklin, of Stanford University.

AT the annual meeting of the National Academy of Sciences, to be held in the United States National Museum, Washington, D. C., from April 23 to 25, Dr. W. W. Campbell, president of the University of California and director of the Lick Observatory, will give on the evening of April 23 an address on "Results obtained by the Crocker Expeditions from Lick Observatory."

ANNOUNCEMENT is made of a course of two illustrated evening lectures, to be held in the Administration Building of the Carnegie Institution of Washington, Washington, D. C., relative to investigations which are now being carried forward by research associates of the institution, as follows: April 19, Dr. R. A. Millikan, of the California Institute of Technology, on "Present problems in the field of atomic structure and their bearing upon the nature of ethereal radiations"; April 25, Dr. A. A. Michelson, of the University of Chicago, on "Application of interference methods to astronomical problems."

PROFESSOR CHARLES MOREU has been elected president of the Chemical Society of France.

UNDER the auspices of the Massachusetts Board of Health, the Boston Board of Health and the department of preventive medicine and hygiene of the Harvard Medical School, a dinner was given recently in honor of Dr. Béla Schick of Vienna at the Hotel Lenox, Boston. Dr. Francis X. Mahoney, city health commissioner of Boston, presided, and Dr. Rosenau was toastmaster. Dr. Schick was presented with a gold set of the equipment used for the Schick test by the city. It was announced that 30,000 children in Boston have been tested since May 1, 1922.

THE New York branch of the American Pharmaceutical Association has awarded the fourth impression of the Remington Honor Medal to Dean Henry Hurd Rusby of the College of Pharmacy of Columbia University, in recognition of his extensive botanical researches and especially for the discovery of a number of important drug plants in his South American explorations.

WE learn from *Nature* that on February 12 Professor Otto Pettersson, director of the Swedish Hydrographic Biological Commission, Gothenburg, celebrated the seventy-fifth anniversary of his birth. Having in early life made a European reputation as a chemist, Professor Pettersson turned his attention to the study of oceanography, and much of the work in that subject during the last thirty years has owed its success to him. His name is particularly associated with the foundation in 1902 of the International Council for the Study of the Sea, of which organization he was president for a number of years.

DR. CHARLES VAILLART, the X-ray experimenter, who lost both arms through his work, at an official reception at the Hotel de Ville, Paris, was presented with the *cravate* of the Commander of the Legion of Honor, the gold medal of the City of Paris, and an inscribed plaque awarded by the Carnegie Trust. Those present included M. Strauss, minister of hygiene; the American Ambassador, Mr. Herrick, and Madame Curie.

ACCORDING to press reports, Professor Albert Einstein, of the University of Berlin, has resigned as a member of the League of Nations commission on intellectual cooperation, on the ground that "the league has neither the strength nor the good will necessary to accomplish its task."

DR. CHRISTOPHER K. INGOLD was awarded the Meldola medal of the Institute of Chemistry at the annual meeting of the institute held on March 1.

PROFESSOR ROBERT E. COKER, of the University of North Carolina, will during the coming summer again serve as director of the biological laboratory of the Bureau of Fisheries at Wood's Hole, Massachusetts.

MR. M. R. CAMPBELL, geologist in charge of the coal section of the Geological Survey for the past sixteen years, has been relieved of this duty at his own request that he may devote himself to the physiographic work of the Survey. Mr. W. Taylor Thom, Jr., has been assigned to succeed Mr. Campbell in the coal work.

MR. C. A. BRIGGS, associate physicist, division of weights and measures, Bureau of Standards, has been transferred to the United States Department of Agriculture to the post of live stock weight supervisor in the packers and stockyards administration.

DR. FRANK APP has resigned from the staff of the Agricultural College and Experiment Station of Rutgers College to become vice-president of the Minch Brothers Company at Bridgeton, N. J.

DR. J. C. KARCHER of the sound laboratory, Bureau of Standards, has resigned to accept a position as technical adviser to the production manager of the Western Electric Company, Chicago, Illinois.

A COMMITTEE of dye chemists has been appointed by the secretary of agriculture upon recommendation of W. G. Campbell, acting chief of the Bureau of Chemistry, to formulate plans of work for the color laboratory. The committee consists of R. Norris Shreve, secretary of the Dye Division of the American Chemical Society; Willard H. Watkins of the National Aniline and Chemical Co., Buffalo; Louis A. Olney of Massachusetts, president of the American Association of Textile Chemists and Colorists; Dr. William J. Hale, of Michigan, chairman of the Dye Division of the American Chemical Society, and Dr. Clarence G. Derick of Buffalo.

MR. N. GIST GEE, for twenty years professor of biology at Soochow University, China, has been appointed adviser on premedical education to the China Medical Board of the Rockefeller Foundation. He will make a study of the teaching of chemistry, physics and biology at colleges in China.

PROFESSOR F. L. WASHBURN, of the University of Minnesota, has returned from the South Pacific with a collection of several thousand specimens of insects for that institution from the Marquesas and Society Islands. Almost all orders are represented, and sufficient material in the various families was secured to afford opportunity for exchange with other institutions. Most of this material was secured at from 100 to 300 feet above sea level, but many specimens were also taken at elevations of 1,500, 2,500 and 2,800 feet.

Professor William H. Haas, associate professor of geology in Northwestern University, has returned from a 9,000-mile journey through South American countries, covering a period of nine months. Accompanied part of the time by Professor Cox, of the department of history, Professor Haas made an extensive investigation of the various mineral deposits of Peru, Bolivia, Chile, Argentina, Uruguay and Brazil.

During the summer vacation, Willard N. Clute, editor of *The American Botanist,* will conduct a party on a botanical exploring trip to the painted desert, Navajo Mountain and the Rainbow Bridge. The region is one practically untouched by botanists. A previous trip brought to light several new species and this year it is hoped to complete a survey of the flora.

A leave of absence for two weeks has been granted by the University of Iowa to Dr. Bird T. Baldwin, director of the Child Welfare Research Station, in order that he may make a trip to Leland Stanford, Jr., University to cooperate with Dr. Lewis L. Terman in a scientific investigation of 1,000 superior children. Dr. Terman has been selecting the most gifted children in California during the past year by means of mental and educational tests. Dr. Baldwin will organize and direct the physical measurements. He will continue his research in the general problem of the relation of physical growth to mental development with this particular group of selected children. Miss Beth Wellman, research assistant in the Child Welfare Research Station, will spend three months in California making detailed physical measurements of each child. The investigation has been financed by the Commonwealth Fund of New York City.

Dr. R. K. Nabours, of the Kansas State Agricultural College, gave the presidential address before the recent meeting of the Kansas Academy of Science on "Eugenics, the limitations and the promise."

Dr. John Howland, professor of pediatrics in the Johns Hopkins University, will deliver the ninth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, March 31. His subject will be "Rickets."

Dr. William Diller Matthew, curator of vertebrate animals in the American Museum of Natural History, gave a public lecture on March 5, at the University of Michigan, on "Evolution and the dispersion of the dinosaurs." He also gave two other lectures of a more technical nature on the general topic, "The evolution and dispersion of Tertiary animals."

The Beaumont lectures for 1923 were delivered before the Wayne County Medical Society at Detroit, January 29-30. Dr. J. R. Macleod, professor of physiology at the University of Toronto, Canada, delivered the first two lectures on "The physiology and pathology of the pancreas and the demonstration of new discoveries of pancreatic hormones." The third lecture was delivered by Dr. F. G. Banting, of the University of Toronto, on "Clinical work on insulin."

Lieutenant Colonel F. H. Garrison, U. S. Army Medical Department Research Board, recently gave a series of six lectures on the history of medicine before the faculty and student body of the College of Medicine and Surgery of the University of the Philippines, Manila.

Leason H. Adams, of the Geophysical Laboratory of the Carnegie Institution, spoke before the Chemical Society of Washington, on March 8, on "Reactions and properties of substances at high pressures."

Professor Meyerhof, the physiologist of Kiel, has been invited to deliver a series of lectures at New York, Boston and Baltimore, and has accepted. He spoke in Cambridge last year on his research on cell respiration and muscular energetics.

On February 13 Professor Cassius J. Keyser, of Columbia University, delivered an address on "Humanity and education" at a joint meeting of the High School Men's Club and the High School Women's Club of Jersey City; on February 27 he spoke on the same subject at a joint meeting of the faculty and senior class of the Packer Collegiate Institute. At a meeting, March 10, of the Association of Chairmen of the Departments of Mathematics of the High Schools of New York City, Professor Keyser gave an address on "Mathematics and man."

DR. CECIL H. DESCH, professor and dean of the faculty of metallurgy in the University of Sheffield, delivered recently the "Second Sorby Lecture" on "The services of Henry Clifton Sorby to metallurgy." The Sorby lectureship has been instituted by Sheffield engineering associations to commemorate the work of Dr. Sorby, who rendered signal service to metallurgy and to microscopy.

THE committee in the Netherlands has collected and presented to Professors Borrel and Weiss at Strasbourg the sum of 10,000 francs toward the monument to Louis Pasteur in the city in which he began his scientific career. The Pasteur Institute of Paris and the descendants of Pasteur will present to the council of the League of Nations a bust of Pasteur, in gratitude for the appointment of a member of the council and a delegation from the health committee of the League of Nations to attend the centenary of Louis Pasteur at Strasbourg.

THE bicentenary of the death of Sir Christopher Wren was observed in London, February 25-March 3. The ceremonies were organized by the Sir Christopher Wren Bicentenary Grand Committee, consisting of representatives of thirty-eight scientific and municipal bodies. Sir Christopher Wren was president of the Royal Society from 1680 to 1682. A memorial volume of essays on various aspects of his life and work has been published, the profits being devoted to the preservation fund of St. Paul's Cathedral, of which Sir Christopher was the builder.

DR. GEORGE BRUNE SHATTUCK, the distinguished Boston physician, for more than thirty years editor of the *Boston Medical and Surgical Journal*, has died at the age of seventy-nine years.

THE death is announced of Clarence Erskine Kelley, instructor in astronomy at Harvard University.

GUSTAVUS DETLEF HINRICHS, formerly professor of physical science at the State University of Iowa, and of chemistry at the St. Louis College of Pharmacy, has died at the age of seventy-seven years.

PROFESSOR W. N. PARKER, emeritus professor of zoology at the University College of South Wales and Monmouthshire, Cardiff, died on February 22, aged sixty-five years.

DR. TERANO, director of the Aeronautical Research Institute in connection with the University of Tokyo, died on January 8, aged fifty-four years.

As has already been reported in SCIENCE in 1920, a committee was formed to commemorate Sir Victor Horsley's services to science. It may be remembered that he died while on service with the army in Mesopotamia, in 1916. The *Journal* of the American Medical Association reports that subscriptions amounting to $5,000 were received from all over the world. The committee, over which Sir Charles Ballance presides, and of which Sir Frederick Mott is treasurer, resolved that the money should be invested in the name of a board of trustees, who should triennially appoint some one to deliver a lecture in London under the title of the Victor Horsley Memorial Lecture. No limitation is placed as to the country or profession from which the lecturer shall be appointed, or as to the subject of the lecture. Sir Edward Sharpey Schafer, professor of physiology in the University of Edinburgh, has accepted the invitation of the trustees to deliver the first lecture, which will probably be given in the autumn.

THE late A. Crum Brown, professor emeritus of chemistry in the University of Edinburgh, bequeathed to the Royal Society of Edinburgh his portrait, painted by Mr. E. A. Walton, presented to him by friends and former pupils. He made provision also for handing over his collection of portraits of scientific men to the department of chemistry of the University of Edinburgh.

THE Baird Ornithological Club of Washington, D. C., held its annual meeting at the Cosmos Club on March 14, 1923. The incumbent officers were re-elected and are as follows: *President,* Dr. A. K. Fisher; *vice president,* Mr. Ned Hollister; *secretary,* Mr. B. H. Swales. A council was formed to consist of the officers and two additional members to which Drs. C. W. Richmond and T. S. Palmer were elected. During the year the club held its regular monthly meetings generally at the home of some one of the members. The meeting of February 20, 1923, was a memorial to celebrate the one-hundredth anniversary of the birth of Professor Spencer Fullerton Baird with special reference to his career as an ornithologist. Drs. W. H. Dall, C. Hart Merriam and Leonhard Stejneger gave reminiscences of their relations with Professor Baird and the latter's standing as a naturalist and administrator.

The American Geophysical Union will hold its annual meeting at the Carnegie Institution of Washington from April 17 to 19, 1923. The first day will be devoted to general addresses respecting the organization and aims of the International Research Council, the United States National Research Council and the American Geophysical Union, followed by special addresses outlining the status and scope of the problems receiving the attention of the several sections of the union. The second day and the morning of the third day will be devoted chiefly to meetings of the respective sections, at which reports of investigational committees and scientific papers will be presented. The union will close its annual meeting with a business session on Thursday afternoon, April 19. (For the present organization of the union, see Science, March 24, 1922, pp. 311-312).

The director of the United States Coast and Geodetic Survey announces that Congress, at its recent session, made an appropriation of $2,000 to the State Department for the support of the International Latitude Observatory at Ukiah, California, during the fiscal year 1924, or until some other provision is made for that station. In the estimates for the Coast and Geodetic Survey for the fiscal year 1924 there was included an item which, if it had been approved by Congress, would have authorized that bureau to carry on the variation of latitude observations at Ukiah as a part of its regular geodetic work. It is hoped that this authority will be granted during the next session of Congress in order that there may be no possibility of a break in the observations for variation of latitude which have been made continuously at Ukiah for the last twenty-three years.

The Senate committee on Reforestation, headed by Senator McNary, of Oregon, left Washington March 18 for the purpose of making investigations in the south. It will conduct hearings and investigations in Florida, Mississippi and Louisiana, going as far as New Orleans. It will return to Washington about April 1 and resume investigations and hold sessions this summer throughout the West and Northwest and in New England.

President Harding, by proclamation, has designated the week of April 22 to 28 as "Save-the-Forests Week." Urging governors of the states to do likewise, the President calls attention to the importance of forest preservation to the industrial and commercial life of the nation and to individual welfare, and points out that fires, which are the result of carelessness or thoughtlessness, do great damage, threatening the timber supply and endangering the cover of watersheds of streams that are used for navigation and irrigation.

The annual congress of the Royal Institute of Public Health will be held in Scarborough, England, from May 16 to 21, under the presidency of Lord Riddell.

It is announced that at a meeting in London on February 15, the National Sea Fisheries Protection Association was formally wound up and a new association, called the Association of British Fisheries, was constituted. This, it is understood, will be recognized by the government as representing every branch of the fishing industry.

A bill now before the Connecticut legislature, entitled "An act for the establishment of a psychiatric hospital," calls for an expenditure of $250,000 for the establishment of the hospital, and an annual appropriation for maintenance on the part of the state. Yale University will provide the site for the hospital, funds for the support of the medical staff and for investigations into the cause, nature and prevention of mental disease. The bill was the result of an investigation by the state psychopathic commission, which reported the need of such an institution and recommended its location in New Haven in conjunction with the school of medicine.

The cornerstone of the Gorgas Institute of

Tropical Medicine at Panama was laid on February 1 by President Porras, assisted by members of the American College of Surgeons touring in South America. The institute will be governed by a board of directors of which Rear Admiral W. C. Braisted, retired, is president and Dr. Richard P. Strong, director of the Harvard University School of Tropical Medicine, is the scientific director.

UNIVERSITY AND EDUCATIONAL NOTES

MR. JOHN HAYS HAMMOND has endowed a scholarship in engineering for a Mexican student at Yale University. The scholarship is for a four years' course and covers expenses of tuition, dormitory, meals, books, fees, etc., and transportation from and to the Mexican border.

DR. GEORGE E. POTTER has endowed a fellowship in pathology in the Detroit College of Medicine and Surgery.

THE new chemistry section of the Technical High School of Stockholm has been opened. The building, which cost 3,300,000 kroner, is said to be one of the largest chemical laboratories of the world. It has four large laboratories for inorganic, organic, technical and electro-chemistry, and a smaller for the study of fermentation. The director is Professor W. Palmaer.

MISS ADA LOUISE COMSTOCK, dean of Smith College, has been appointed president of Radcliffe College, in succession to Dr. Le Baron R. Briggs, who for twenty years has been head of Radcliffe and dean of the faculty of arts and sciences at Harvard University.

DR. IRA N. HOLLIS, for ten years president of Worcester Polytechnic Institute, and previously professor of engineering at Harvard University, has offered his resignation to the board of trustees.

DR. ARTHUR HOLLY COMPTON, head of the Department of Physics in Washington University, has been appointed professor of physics at the University of Chicago.

PROFESSOR STRAUB of Freiburg has been called to Munich to occupy the chair of pharmacology as successor to Professor von Tappeiner, who is to retire on account of his advanced age.

DISCUSSION AND CORRESPONDENCE

AN UNUSUAL OCCURRENCE OF ROCK BORING MOLLUSKS IN CONCRETE ON THE PACIFIC COAST

IT has often been supposed that concrete in sea water might be subject to attack by rock boring mollusks, especially of the family Pholadidæ, various species of which perforate rocks of a number of different kinds and often of a considerable degree of hardness. But specific instances of the occurrence of these organisms in concrete marine structures have been lacking. Hence the data here reported are of considerable interest from both the biological and engineering points of view.

In the work of widening the channel in Los Angeles harbor, about November 13, 1922, it became necessary to remove some old wooden piling which had been protected from marine borer attack by jacketing with concrete. It was discovered by Mr. D. E. Hughes, engineer in charge of dredging operations, that, of 18 such jackets examined at this location, 16 had been more or less attacked by pholad borers. About five were considered to be badly attacked, containing six or more borers per square foot of exposed surface; the others contained fewer, and some only an occasional borer. The two jackets not attacked stood in shallower water than the others. The jackets had been in place fourteen years, but had not been exposed to rock borer attack during the entire period, as the form lumber had been left about the jackets when they were constructed, and this gave protection from the rock borers until the wood was destroyed by wood boring organisms. In some cases, indeed, a thin shell of the old form lumber still remained adhering to the concrete.

Attention of the writers was called to this finding, and, with the cooperation of the Los Angeles Harbor Engineering Department and the San Francisco Bay Marine Piling Committee, collaborating with the National Research Council committee on marine piling investigations, a further investigation was made. It was found that, of concrete jacketed piles at four different locations in Los Angeles harbor, in fact, at every point in the inner harbor where such piles exist, about 50 per cent. had been more or less attacked, of which rather more than one fifth were very considerably bored. Of those not attacked, a number stood so far inshore as to be but little exposed to the action of the borers.

These jackets were in general of a less than average grade of cement mortar, from 2 to 5 inches in thickness, some being decidedly poor, others fairly hard, as indicated by the fact that some of the jackets had given service in sea water over a period of fourteen years. Samples of the best mortar in which borers were found showed an air penetration of 1/16 inch in seven weeks when tested with phenolphthalein. Mr. A. A. M. Russell, testing engineer to the California State Harbor Board, has very kindly made a crushing test of a sample of one of these jackets, finding the crushing strength of a specimen 2½"x3½", 4" high, to be 1,726 pounds per square inch. Mr. Russell reports the grading of the aggregate to be as follows:

Screen	*Percentage*
10- 20	1.78
20- 30	.89
30- 50	4.46
50- 80	51.78
80-100	16.07
100-200	16.07
Pass 200	8.94

The species occasioning most of the damage here was found to be *Pholadidea penita* Conrad, a borer which occurs in suitable habitats from Alaska to Lower California, and possibly even to Ecuador.[1] Specimens taken from these pile jackets averaged about 4 cm. in length, with a maximum length of 7 cm. and a maximum diameter of burrow of 3.2 cm. In some cases the borers had gone entirely through the jackets until in contact with the wood within, but none had continued boring into the wood.

The nestler *Petricola carditoides* Conrad was found somewhat commonly in these jackets, but presumably only in old pholad burrows. *Platyodon cancellata* Conrad was also found sparsely, in badly disintegrated concrete.

The wide distribution of *Pholadidea penita* suggests possibilities of attack on concrete marine structures in other Pacific Coast harbors. Indeed, reports of such action by this or a similar borer at such widely separated points as Anchorage, Alaska, and Panama, have recently come to hand.

In jacketing piles, it has often occurred that the concrete has been "drowned," either by the presence of too much water in the mix, or by depositing the material in water, causing segregation and laitance, and rendering such structures especially liable to borer action. The probabilities of attack on well made precast piles and other high grade concrete structures hinge upon whether the action of the borers is mechanical or chemical, or both. If it be predominantly chemical, density of the material will probably serve only to make the boring slower. It appears, at any rate, that the use of concrete for marine construction is not as yet a final solution to the marine borer problem, at least in localities where rock boring mollusks occur.

Charles A. Kofoid
Robert C. Miller
Zoological Laboratory,
University of California

AN INTERESTING LIVERWORT

A short time ago, one of my students, Mr. T. Domoto, brought to the laboratory a peculiar liverwort which at first I had some difficulty in identifying. The specimens were collected in a nursery in Oakland, owned by his father.

A further investigation of the plant showed that it was undoubtedly the curious *Monoselenium tenerum*, Griffith, described in detail by Goebel[1] about a dozen years ago. So far as I know, the plant has not been reported since that time.

Goebel's specimens were found growing in earth sent from Canton to Munich with specimens of tea plants. The liverworts were first noticed some time after the arrival of the material in Munich.

Goebel decided that the plant was Monoselenium, of which the only account was in the posthumous notes of Griffith.[2] No specimens are known in herbaria; but Goebel concluded from Griffith's description and figures that Griffith's *Monoselenium tenerum* from India was the same as the Canton plant.

Monoselenium closely resembles a small Dumortiera, and in spite of certain differences which Goebel points out, I am inclined to believe that the two genera are pretty closely related. In Monoselenium there is a marked degeneration of the sporophyte, the elaters being quite rudimentary. Spores and elaters of the Oakland specimens agree exactly with Goebel's figures.

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[1] Dall, W. H.: Proc. U. S. Natl. Museum, 37, 276. 1910.

[1] Flora, 101: 43-97. 1910.

[2] Posthumous papers. Part II (1849)—Notulæ ad Plantas Asiaticas, p. 34.

There can be no doubt that the Californian specimens have been introduced with nursery stock from China or Japan, and a careful search in those countries would probably show that the plant is not an exceptionally rare one.

DOUGLAS HOUGHTON CAMPBELL
STANFORD UNIVERSITY

COAL BALLS

I AM anxious to obtain information on American coal balls, such as have been found mostly, up to now, in the coal seams of England and northern France, and which were used by J. Lomax in Bolton, England, for his magnificent thin sections of paleozoic plants. The coal balls have not been reported anywhere in North American coal seams, but they exist here. A splendid specimen of such a coal ball was obtained by the Illinois State Geological Survey at Harrisburg, Illinois, O'Gara Mine No. 9, and others were collected by myself in coal seam No. 5 in Illinois and coal seam No. 9 in Kentucky. Recently a coal ball from Newcastle, Texas, was sent to me by W. E. Wrather. These so-called coal balls are well preserved and petrified plant tissues which appear in brown or black lumps in upper portions of coal seams. Their preservation is due there to penetration by silica or calcium carbonate. They allow microscopic examination of the most minute details. I think some of the bone coal, called so by miners, and quoted occasionally in literature, may be coal balls.

It would be extremely gratifying if a sufficiently large number of American coal balls would be discovered to increase materially our knowledge of carboniferous plant morphology which is now exclusively based on English and French material. I shall be very glad to receive any communications from coal operators or state surveys which may lead to the discovery of deposits of coal balls.

A. C. NOÉ
UNIVERSITY OF CHICAGO

A FUND FOR GERMAN AND AUSTRIAN LABORATORIES RAISED BY THOSE WHO HAVE WORKED IN THEM

"We should rather through the instrumentality of men of science soften the asperities of national hostility."—Humphry Davy to a delegation from the French Academy which went to London in 1807 while war was in progress between England and France.

The desperate financial condition of the German and Austrian laboratories is well known. If any one desires to help a specified laboratory or a specified head of a laboratory, any contribution given will be sent as from the donor directly to the individual in charge of such laboratory.

The following individuals were the first to subscribe to this fund, which already reaches $2,175:

Abel, J. J.; Baldwin, E. R.; Carlson, A. J.; Chittenden, R. H.; Conner, L. A.; Cushing, H.; Dakin, H. D.; Farnam, H. W.; Greenwald, I.; Hatcher, R. A.; Howland, J.; Kerr, A. T.; Kingsbury, B. J.; Lee, F. S.; Lilienthal, H.; Lusk, G.; Marine, D.; Means, J. H.; Meigs, E. B.; Mendel, L. B.; Niles, W. L.; Palmer, Mrs. W. W.; Peabody, F. W.; Pierce, H. F.; Pike, F. H.; Pratt, J. H.; Pritchett, H. S.; Ringer, A. I.; Robinson, C.; Scott, E. L.; Shaffer, P. A.; Simpson, S.; Sollman, T.; Stern, Miss F.; Talbot, F. B.; Tiffany, Mrs. C. L.; Wallace, G. B.; Wilder, R. M.; Woodyatt, R. T.

Checks of $5 to $150 have been received: any sum will be welcomed.

Make checks payable to Graham Lusk, *Treasurer,* 477 First Avenue, New York City. The fund will be closed on May first.

GRAHAM LUSK
CORNELL MEDICAL SCHOOL

QUOTATIONS

SCIENCE AND THE PACIFIC

ON the invitation of the Commonwealth Government, which has promised the sum of £5,000 towards the cost, a Pan-Pacific Congress is to be held in Melbourne and Sydney in August and September of this year. The National Research Council of Australia has arranged an extensive program and invitations are being issued to the scientific men of countries bordering on, or having interests in, the Pacific. The Pacific Ocean is a geographical and biological unit, and many problems of scientific and practical interest can best be solved by the cooperation of people with local knowledge—if, indeed, the word "local" can be applied to so large a part of the surface of the globe. The first Pan-Pacific Congress was held at Honolulu in 1920, on the initiation of the National Research Council of the United States, which issued the invitations and arranged the program. In commenting at the time on this striking evidence of the growing importance of the Pacific in the economy of the world and of the shifting of the center of gravity of American interests from the Atlantic seaboard, we remarked that the world was round, and that the congress at Honolulu would reach problems which the British Empire approaches from the other side.

We are the more glad to record the important step taken by Australia and to offer our best wishes for the success of the meeting this year. Although the United States and Canada, Australia, New Zealand, China and Japan have the more immediate interest in the science of the Pacific, there is no geographical limit to the advantages gained from the acquisition of knowledge. Not long ago it was thought, for example, that meteorology of the northern hemisphere could be investigated sufficiently without reference to what takes place south of the equator. But the world is an organic whole, and the storm centers, currents of the air and of the oceans, even the vibrations of the solid earth, have a general effect. The geology, the animals and plants, the races and the habits of men in any one part of the world must be understood if we are to advance in our knowledge of any other part of the world to comprehend the past, to adapt ourselves to the present and to make reasonable anticipations of the future. It is to be hoped that the leading scientific bodies in this country will send delegates to the Pan-Pacific Congress in Australia.—*The London Times.*

SCIENTIFIC BOOKS

THREE OF A KIND

Handbook of Meteorology, A Manual for Cooperative Observers and Students. By JACQUES W. REDWAY. John Wiley and Sons, 1921. 294 pp. Price $4.00.

The New Air World, The Science of Meteorology Simplified. By WILLIS LUTHER MOORE. Little, Brown and Company, 1922. viii + 326 pp. Price $3.00.

Climatic Changes, Their Nature and Causes. By ELLSWORTH HUNTINGTON and STEVEN S. VISHER. Yale University Press, 1922. xiii + 329 pp. Price $3.50.

The above three of America's latest book contributions to meteorology have a peculiar group distinction (that is why they are reviewed *en bloc*), the distinction of running from horrid to worse in whatever order one may read them.

Mr. Redway says that his book was written "for the use of cooperative observers and for the instruction of students in meteorology and aeronautics." But no such worthy purpose can be accomplished by a book that literally has more errors and loose statements than pages, especially when many of these errors are fundamental.

A few "horrid examples," selected from a very great number, will indicate, perhaps, what radical revision this book must undergo before it can be recommended for serious use:

Page 2: "Carbon dioxide is not observable above an altitude of two or three miles." But it is "observable" at much greater altitudes, as we know from those who have made such observations, and as we are compelled to assume from the fact that vertical convection keeps the atmosphere well mixed through a depth of six or seven miles.

Page 3: Here it is stated that at the surface of the earth ozone amounts to twelve parts (whether by weight or by volume is not stated) per million of the atmosphere. Presumably the author found this statement somewhere, but at the same time he had access to the results of those modern observations that have shown that the lower atmosphere contains no more than bare traces of ozone.

Page 6: "Strictly speaking, it is the vapor itself and not the space, nor the air, which is saturated." Obviously, the author got the idea in some way that it is not scientifically exact—and it is not—to say that the air is saturated, and then deliberately made a worse statement.

Page 12: The various statements on this page, largely mere jumbles of words, are good examples of the way one is likely to write about force, heat, energy and power, when he has no clear conception of any of them.

Page 14: "If a given volume of gas—say a cubic foot of oxygen—be introduced within a container, its pressure or tension noted, the same volume of another gas having the same tension may be introduced without an increase of tension of the mixture." This deals with a fundamental property of gases, and is as wrong as it would be possible to make it. It is not a slip, either, for it is stressed by an example, wrong, of course.

Page 16: "as they [non-visible radiations] fall on the body, they produce the sensation of warmth, thereby stimulating the growth of living matter." Perhaps it might be a good exercise to grope one's way through this mental fog.

Pages 21-22: The "solar constant" is discussed on these pages, but in a sense (just what sense is not clear) entirely different from that of the authors cited.

Page 23: " . . . heat radiated from the earth's interior to the surface." What, indeed, does the author mean by "radiated?"

Page 41: "In centigrade terms, the increment is 0.00037 for each degree, measured from the absolute zero." This does not confuse, however much it may irritate, any one who knows that for "increment" he should say "coefficient of expansion"; that 0.00037 is one tenth the proper value; and that for "absolute zero" he should substitute "freezing point." But think of the predicament of the reader of this book who does not know these things!

Page 54: "This [condensation] liberates a great deal of latent heat, materially warming the air." But the air is not warmed by the setting free of latent heat. The upper portion of a cloud is always colder than its lower surface however much the condensation, and however great the liberation of latent heat.

Page 73: "One can not say why cloud matter floats in the air, apparently contrary to the laws of gravity." If he can not, and wants to know, why not ask the first physicist he happens to meet, or, one would think, most any one else?

Page 116: "The most extraordinary effects of lightning are the dark flashes occasionally caught in photographs of lightning." This is only a peculiarity of the photographic plate and not anything extraordinary about the lightning, as the author had every opportunity to know.

Page 121: "The simple halo is practically a rainbow." This is a good example of the exceedingly numerous loose and utterly misleading statements in this book. Certainly no one who understands the halo and the rainbow would dare say that they are practically the same.

Page 122: "They [iridescent clouds] may be due to causes similar to those which produce halos, but the causes are not known." They are not so produced, and their well-known cause has been widely published.

Page 158: "Possibly the conjunction of planets may affect the movement and formation of storms." Obviously, then, the author does not really believe that an effect must have had an adequate cause.

Page 255: "The convenient unit of magnetism is one which attracts or repels an equal quantity at a distance of one centimeter." "An ampere, the practical unit of current, is the electromotive force of one volt against a resistance of one ohm."

About as accurate as the schoolboy's definition of the equator—a menagerie lion running around the earth—and typical of the whole book from start to finish.

The best feature of the book, and that a commendable one, is its considerable number of good to excellent cloud pictures. The two or three faulty legends can easily be corrected.

The author of the second of the books here under review arouses the anticipation of something exceptionally fine by signing himself "Sc.D., LL.D., Professor of Meteorology George Washington University; eighteen years Chief of the United States Weather Bureau." But this promise is not kept, for neither the mere grammar-school grade of what follows, nor its scores of errors and numerous loose and inaccurate statements, are what would naturally be expected from one having such degrees and so long occupying the most important position in America in connection with the science he professes to be elucidating.

Time and again the matter under a sub-title is only an aimless ramble that explains nothing and has but little relation to the supposed subject.

But to cite specifically a few of the many errors—to note and explain all would require a book:

Page 8: "The atmosphere is thus by absorption of radiation warmed largely from the bottom upwards, which accounts for the perpetual freezing temperatures of high mountain peaks, although they are nearer the sun than are the bases from which they rise." This, as any physicist knows, is a wholly inadequate explanation of the phenomenon in question. Absorption at the surface in excess, on the average, of radiation; and radiation by each portion of the upper air, up to eleven kilometers, roughly, above sea level, *in* excess, on the average, of absorption, are the necessary and sufficient causes, through the convection thus maintained, of the practically continuous state of decrease of temperature, in this lower portion of the atmosphere, with increase of height.

Page 9: "The temperature at this altitude [100 miles] must be that of outside space, probably 459° F. below zero. Air liquefies at 312° below, and therefore it can not exist in the gaseous state in a region having a lower temperature. When it liquefies it has the color and general appearance of water, and about the same specific gravity."

The expression "temperature of outside space" is a familiar string of words to which, as a rule, no particular meaning seems to be assigned, nor, literally, has it any meaning. If we agree that it shall mean the temperature to which a small "black body" would come if placed at the point in question, then by terrestrial radiation alone the temperature one hundred miles above the surface of the earth would be, roughly, —70° F., and not —459° F.

This seems to be one of the author's favorite errors, for he repeats it in one form or another in several different places.

The temperature, —312° F., below which, it is stated, air can not exist in the gaseous state, is the boiling point of liquid air *at atmospheric pressure*. Air, therefore, can exist in abundance in a gaseous state at lower temperatures. In fact, at —346° F. it (at least the nitrogen) would exist in a gaseous state at a pressure one tenth that of a full atmosphere.

The density of liquid air is only 90 per cent., approximately, that of water, instead of "about the same."

Furthermore, the color of liquid air is a pale, steel blue, a color that does not pertain to water.

Page 9: "At this distance [fifty miles] from the earth there probably is no more air than would be found under the receiver of the best air-pump, and, the reader will be surprised to learn, darkness is practically complete, although the hour may be midday, for there are no dust motes to scatter and diffuse and render visible the rays of the sun."

This is another of the author's pet errors, often repeated, and of long standing. Why reflection, or scattering, is essential to render solar rays visible, is not explained. Seemingly, the author confuses transparency, absence of haze and "good seeing" with darkness!

Page 23: "The ingenuity of the Wrights transformed the weather man's kite, strengthened it, took out the ends, hitched on a rudder, and when the petrol engine had developed sufficient power with a given weight, installed it, and flew."

As the wag explained: From "Middletown" drop the "town," change "iddle" to "oses," and we get "Moses"!

Page 24: "As a result of the explorations of the atmosphere made by the institution at Mount Weather, there was ready for our fighting air men at the front, immediately on our entry into the World War, a fund of useful information concerning a region that but a short time before was entirely uncharted."

These excellent data were, indeed, much used in the United States, but it would be fair to infer from the above statement that no such information was available from any other source. As a matter of fact, there were many times as much information of this kind available from the immediate seat of the war, published, and, doubtless, in every meteorological library.

Page 25: "If the aerial explorer could stop his ship and keep it at an altitude of about one and a half miles for twenty-four hours he would be startled to find that the coolest time of the period was during the daytime, not during the night, as he had expected to find it."

No doubt, and he would be even more startled if he had first studied the records and found, as he would have, that in general the lowest temperature at that level *is* at night, or, more exactly, at 5 to 6 A.M., substantially as at the surface.

Page 40: "Ozone is highly electrified oxygen."

News, presumably, to the chemist; and in excellent keeping with the rest of the nearly two pages under the subtitle *Ozone*.

Page 53: "The music of the spheres is not a myth; the lily or the rose as it opens its petals to receive the benediction of the morning sun may give forth a veritable pæan of joy. A rose-bush may be a grander symphony than anything that Beethoven ever wrote. What to us is the invisible light may be the illumination that guides the sweep of the angels' wings."

The reviewer prefers to let his reader say it!

Page 62: "Bodies or planets without atmospheres have temperatures approaching absolute zero. . . . Our moon is an illustration."

Indeed, an excellent illustration, and it tells a very different story.

Page 124: "But early in its [air of the anticyclone] descent it gains such heat as to melt and evaporate the ice spiculæ floating at the height of the fleecy cirrus clouds; then it evaporates and clears away the moist clouds lower down and finally creates such *diathermacy* that the heat lost by radiation to a clear sky causes what we call a 'cold wave.'"

This is meteorology simplified, indeed, but at the expense of facts, logic and the laws of nature.

Page 188: "If the surface of the earth were all land, and the axis of the earth's rotation were perpendicular to the plane of the earth's orbit . . . . there would be no wind."

What, then, does the author imagine would produce a wind?

Page 190: "With a water surface there would be an atmosphere nearly if not quite saturated with vapor of water."

Assuredly not, and for reasons any meteorologist can easily supply.

Page 226: " . . . snow knee-deep to a boy of ten hardly comes up to the ankles of a man of six feet two."

This, of course, is a mere trifle, but it is typical of the inaccuracies, apart from positive errors, that crowd the book from cover to cover.

Page 287: "There is a difference of opinion among meteorologists as to whether the thunderstorm whirls about a vertical axis, like the tornado and the hurricane, or whether it rotates about a horizontal axis."

There should not be, and is not, this difference of opinion, as the thunderstorm does not whirl or rotate about any axis.

Page 287: "One may well account for the formation of the hailstone by assuming that its alternating layers of snow and ice are caused by the horizontal roll of a thunderstorm."

The author's idea as to how a hailstone could go round and round in a vertical orbit, as he assumes, and not fly out on the first turn, would be interesting.

The chapter that tells how to forecast from the daily weather map is helpful, and would have been good if only the author had refrained from attempting to explain the phenomena.

The third of the books listed for this review is notable for two things: (*a*) The number of eminent scholars (the name of one of them wrong) listed in the preface as proof-readers, contributors and "almost co-authors"; (*b*) the fact that it is being offered to the public by the Yale University Press. It is notable in these respects because each would seem to guarantee reasonable accuracy, and a definite contribution to knowledge, whereas, in large measure, its broader conceptions are mere fantasies, while its details show little regard for facts and none for physics. Surely the authors of this book must be like the Scotchman who on looking over the doctor's bill inquired: "What is this item of five pounds for?" "For the advice I gave you." "Weel," said the Scotchman, "I niver took it!"

Frequent reference is made to a companion volume, *Earth and Sun*, said to be "in press" (a poetic license, apparently) for proof of this or that startling assertion, and one would like to see this first volume before reviewing the second. However, it would seem useless to wait for an alleged proof that two and two make a dozen before expressing an opinion on the subject.

The main hypotheses of the book are:

1. " . . . that the earth's present climatic variations are correlated with changes in the solar atmosphere."

But there remains to be proved (*a*) that the solar atmosphere has, in historic times, changed to a greater extent than it has, as indicated by spots, during the past century; (*b*) that the earth's climates have in the same time similarly changed; and (*c*) that these changes were causally related. The reviewer is unaware of any conclusive, or even strongly presumptive, evidence of such changes, or relation.

2. " . . . that variations in the solar atmosphere influence the earth's climate chiefly by causing variations in temperature, but also in storminess, wind and rainfall."

The change in the average temperature that parallels a sunspot cycle is known to be small, of the order of 1° C., and a physicist would look for the other weather elements, all of which depend upon temperature, or temperature differences, to be also but little affected. But the authors of this book are not physicists, so they can boldly conjure with electricity, or electromagnetism, as a variant, as the sorcerer used to with his "abracadabra," to make good their every climatic claim, nor do they ever save the reader's confusion by calculating magnitudes for him.

3. " . . . that if the climatic conditions which now prevail at times of solar activity were magnified sufficiently, and if they occurred in conjunction with certain important terrestrial conditions of which there is good evidence, they would produce most of the notable phenomena of glacial periods."

No doubt, and if a billy-goat were big enough and hitched tandem to an engine, the two might pull a train; however, this is no proof that billy-goats used to be giants, nor that trains ever were pulled that way.

In addition to the main hypotheses, there are several others, unessential, it is said, yet obviously cherished, as they bulk large in pages, and are to be further and chiefly discussed in "Earth and Sun." Together, these fancy that whenever we come within so many billions, or hundreds of billions, of miles of a fixed star (Alpha Centauri being the latest of the guilty), its electric state sets whirling the spots on our own sun; and that these spots in turn electrically, or electromagnetically, whichever reads best, drive our weather cyclones off their more peaceful paths and whip them up to higher speed and deeper intensity, thereby bringing on the storm and stress of an ice age, and, by shaking loose many a stalled earthquake, building the mountain chain. And there is a table, too, that conveniently tells us at what distance this and that type of fixed star would, in the above obvious manner, glaciate our globe.

The limit to Jules Verne's meteorology was the green ray, hence one can not but sympathize with the centenarian who said: "If the world continues to progress during the next hundred years as fast as during the last, I fear I may not keep up with it."

There are also numerous statements that range from the provokingly loose to the positively false, such as, among many others:

Page 8, and elsewhere: "The temperature of empty space is the absolute zero." This is an old stereotyped formula that, literally, is without meaning. If we agree that it shall mean the temperature to which a small object would come if placed there, then, to be at all definite, we must specify where the place is with reference to other bodies, and what the object is, conditions that would provide a range of thousands of degrees Centigrade, but in no case the absolute zero.

Page 9: " . . . the two most critical of all possible temperatures, namely, the freezing point of water, 0° C., and the temperature where water can dissolve an amount of carbon dioxide equal to its own volume." Passing over the questionable use of "where" in this quotation, and the vague concept implied by an amount equal to a volume, and assuming that in this case "amount" means volume, one is still puzzled to know why this *exact* equality, a function of both temperature and pressure, is so vital.

Page 12: "No other known compounds (than those formed by water and carbon dioxide) can give off or take on atoms without being resolved back into their elements." How about the numerous "-ous" and "-ic" compounds, for instance?

Page 12: " . . . the boiling point, where all water finally turns into vapor." Must we, then, infer that a puddle will not dry up unless it is heated to the boiling point? The statement is vague also in other respects.

Pages 21-22: Here the idea is advanced that with greatly extended oceans the temperature difference from equator to poles would become much less and both the trade winds and the westerlies stronger. This might pass in a dream, but when awake we are confronted by the fact that the strength of these general winds, and most others, is proportional to the horizontal pressure gradient, and that this in turn is proportional, in general, to the corresponding temperature gradient. Perhaps the authors should be congratulated on their ability to keep their cake and eat it too!

Page 35: " . . . the hypothesis (Croll's) calls for the constant and frequent repetition of glaciation at absolutely regular intervals." It calls for regularly recurring advances and retreats of the ice front during irregularly recurring glacial epochs.

Page 48: Here the volcanic dust hypothesis is dismissed with the assertion that the Pleistocene glacial period, if so caused, would have required fully 75,000 volcanic explosions of the Krakatoa type, a far greater number than field data allow us to assume.

This would, indeed, be a staggering blow but for the fact that, in reality, the hypothesis does not demand even one in a hundred of this number.

Pages 51-63: The whole of this chapter, "The Solar Cyclonic Hypothesis," has so little and doubtful statistical support, and to such an extent explains (?) the little known by the wholly unknown, that any detailed criticism would be both tedious and useless. It can be recommended to those only who are fond of the curiosities of "cloister" science.

Page 113: "The marked increase in the number of tropical cyclones which accompanies increased solar activity (sun spots) . . . ." But in "Hurricanes and Tropical Revolving Storms," published by the British Meteorological Office, 1922, it is shown that no such relation exists in any part of the world, except, perhaps, in the region of Mauritius, and even there not for the severer storms.

Page 115: " . . . at times of many sunspots, as Kullmer has shown, the storm track tends to be drawn poleward, perhaps by electrical conditions." Professor Henry has explained, *Monthly Weather Review*, 49, p. 283, 1921, that the data used by Kullmer do not justify his conclusions. Then, too, why assert that such a shift, if it occurs, may be due to electrical actions? One gets impatient with assertions that are not backed up by logic and calculations.

Page 116: " . . . ice . . . is much more transparent to heat [than is water]." One must be excused for asking for the authority for this statement, especially as Bode, *Annalen der Physik*, 30, p. 326, 1909, found the difference, if any, to be very small.

Page 136: This page carries one of the few numerical calculations in the book—namely, 10,000/300; and the answer given is 40.

Page 174: "The existing abnormal changes, which we call weather, have their origin chiefly, if not entirely, in the variations of solar radiation." This is taken from another author, but adopted without question. It prompts one to ask whether, for instance, the eddies in the Niagara Gorge are due to variations in the amount of water passing over the falls.

Page 231: "Some such temperature (-273°C.) prevails a few miles above the earth's surface, beyond the effective atmosphere." Absolutely not, and far from it, as everyone knows who has any acquaintance with the theory of the isothermal condition of the upper air.

As already stated, the above quotations from this book are only samples of the many shocks and surprises it contains for any one accustomed to accuracy and to the notion that every effect must have had an adequate cause.

But bad as these books are they are only typical of that huge mass of toxic mental food so persistently thrust upon the public. "Yes, I know that," is the ready and common response, "but what can be done about it?" Anything we sufficiently want done. The packer is no more a chemist or bacteriologist or other kind of scientific specialist than is the publisher, and yet we have found a way, fair to all concerned, that insures to us reasonable purity and wholesomeness of our physical food; and the same can and should be done for our mental food, though better done by a different method.

W. J. Humphreys

SPECIAL ARTICLES

THE INITIAL ENERGY OF THERMIONIC ELECTRONS

MEASUREMENTS of the initial energy of thermionic electrons have been made by Richardson and Brown, Richardson, Schottky and Sih Ling Ting, working under Richardson.[1] With the exception of Ting's work these experiments substantially confirmed the belief that electrons are emitted from a hot body with velocity components distributed according to Maxwell's law for a gas having the temperature of the emitting surface and molecular weight equal to that of the electrons. The measurements of Ting, however, were quite at variance with the former results, and his experimental conditions were apparently better than those under which Richardson had worked.

The present investigation was undertaken with the hope of getting more reliable data than have been hitherto obtained and with the expectation of carrying out measurements upon the distribution function over a very wide energy range. The experimental method of Schottky was adopted. In order greatly to extend the range of the measurements, various experimental refinements have been found necessary, but the method is essentially that of Schottky's work.

The source of the thermionic electrons is a straight tungsten filament lying along the axis of a cylindrical electrode. The experiment consists in the determination of the fraction of the total number of electrons from this filament which possesses sufficient initial energy to move against an opposing electric field and to arrive at a small opening in the cylinder near its center. This fraction is determined as a function of the potential between filament and cylinder, emission currents being measured only during short intervals of time during which the entire surface of the filament is at the same potential.

In the former work upon this subject the fastest electrons measured have had energies corresponding to a potential difference of about 2 volts. In the present experiments the fastest electrons measured have energies corresponding to about 5.35 volts. This is at a filament temperature of 2475° K. giving a saturation emission of .24 x 10^{-8} amp. Measurements have yet to be made at considerably higher temperatures and it seems probable that the distribution function will be investigated as far as "6-volt electrons" at these higher temperatures.

If the emitted electrons leave the filament at the temperature T with velocities distributed according to Maxwell's law the fraction of the saturation current which reaches the surrounding cylinder at a potential φ negative to the filament is given by,

$$\frac{i}{i_0} = \frac{2}{\sqrt{\pi}}\left\{\sqrt{\frac{\varphi e}{kT}}\,\epsilon^{-\frac{\varphi e}{kT}} + \int_{\sqrt{\frac{\varphi e}{kT}}}^{\infty} \epsilon^{-x^2}\,dx\right\} \tag{1}$$

Here e is the electronic charge and k is Boltzmann's gas constant. The derivation of this expression, which was given by Schottky, assumes the diameter of the filament small in comparison with the diameter of the cylinder and the elimination of end effects at the extremities of the latter. In the present experiments these requirements are satisfactorily met. Furthermore, this equation holds only for values of φ so large that the potential of the collecting cylinder is more negative than the potential of any region between it and the filament.

The experimental data which have been obtained are in excellent agreement with this theoretical equation. Data have been obtained connecting i/i_0 and φ at eight different temperatures ranging from 1440° K. to 2475° K. These temperatures are determined with fair accuracy. At the lower temperatures the data are given throughout by the above equation within the limits of error of the measurements. At the higher temperatures the data deviate from the theoretical relation only for values of φ near zero, and in the direction to be anticipated from the mutual repulsion of the electrons in the space between the electrodes. No one of the eight sets of data is satisfactorily represented by equation (1) if the value of the temperature T is taken 10 per cent. in error.

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[1] Richardson and Brown—Phil. Mag. 16 p. 353 (1908).

Richardson—Phil. Mag. 16 p. 890 (1908); 18 p. 681 (1909).

Schottky—Ann. d. Phys. 44 P. 1011 (1914).

Sih Ling Ting—Roy. Soc. Proc. 98 P. 374 (1920-21).

The range of the measurements which have been made thus far is as follows:

1440° K.—1.0×10^{-11} amp. saturation current to 1.0×10^{-14} amp. at 1.02 volts.

2475° K.—$.24 \times 10^{-3}$ amp. saturation current to 2.0×10^{-14} amp. at 5.35 volts.

Data are still to be taken at temperatures below 1440° K. and above 2475° K., and at all temperatures the range of the measurements may be somewhat extended by further refinements to eliminate some of the disturbing factors which are still present.

L. H. GERMER
RESEARCH LABORATORIES OF THE
AMERICAN TELEPHONE AND TELEGRAPH
COMPANY, INC.
AND THE WESTERN ELECTRIC COMPANY, INC.
MARCH 5, 1923

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE thirty-fifth annual session of the American Physiological Society met at the University of Toronto, Toronto, Canada, December 27, 28 and 29, 1922. The scientific meetings were held in the physiological lecture room of the University of Toronto. There were six scientific sessions lasting through three days with over seventy-five titles. Two of these sessions were combined programs in which the physiologists joined with the biochemists, pharmacologists and pathologists of the Federation of American Societies for Experimental Biology. Of the sessions the combined program of the last afternoon discussing various aspects of the internal secretion of the pancreas and its physiological rôle in the body aroused the greatest enthusiasm and the largest general attendance. The individual programs as a whole were of high quality and of the usual variety, covering all fields of physiological endeavor. The American physiologists are justly proud of the high standard of the research contributions.

The most important business transacted at the annual session was the following:

Dr. William T. Porter, of Harvard University, continued his research fellowship grant of $1,200. The council announced the appointment to this fellowship for the year 1922-23 of Miss Florence B. Seibert. The occupant of the fellowship under the terms of the grant is privileged to choose any research laboratory in which to carry forward the researches. Miss Seibert elected to work under the guidance of Professor L. B. Mendel, of Yale University.

It was announced by the council that Dr. William T. Porter had donated to the society all the remaining volumes and plates of the *American Journal of Physiology* issued under his editorship. This generous grant puts the society in possession of all the reserve sets of the *American Journal of Physiology.*

The council reported before the society that the *American Journal of Physiology,* now in its sixty-fourth volume, and *Physiological Reviews,* now in its third volume, were both at the present time self-supporting with a sufficient credit balance to maintain publication on a very stable basis. The commendable financial condition of the journals is largely credited to the conservative and skilful financial management of the managing editor, Dr. Donald R. Hooker, of Baltimore. As an expression of appreciation by the membership of the society as a whole, Dr. Hooker was given an enthusiastic vote of thanks for his unselfish and tireless labors in maintaining not only the financial success but the high research ideals and standards of publication in the journals of the society.

Dr. Donald R. Hooker was elected managing editor of the *American Journal of Physiology* for the year 1923. The board of editors for *Physiological Reviews* designated for 1923 consists of:

William H. Howell, Johns Hopkins School of Hygiene, *chairman*; Donald R. Hooker, Baltimore; J. J. R. Macleod, University of Toronto; L. B. Mendel, Yale University; Reid Hunt, Harvard University; H. Gideon Wells, University of Chicago; Walter J. Meek, University of Wisconsin.

Professor A. J. Carlson, University of Chicago, was nominated representative of the society on the National Research Council.

The following scientists were elected to membership in the society:

Thomas Addis, M. D., professor of medicine, Stanford University.

Janet Howell Clark, A.M., Ph.D., associate in physiological hygiene, School of Hygiene, Johns Hopkins University.

Roger Sanford Hubbard, A.M., Ph.D., biological chemist, Clifton Springs Sanitarium, Clifton Springs, N. Y.

David Rapport, M.D., fellow of the National Research Council, 1922-23.

M. H. Rees, A.M., Ph.D., M.D., professor of physiology and pharmacology, University of Colorado.

Norman B. Taylor, M.B., M.R.C.S., F.R.C.S., assistant professor of physiology, Toronto University.

J. Earl Thomas, M.D., associate professor of physiology, St. Louis University.

The officers elected for the year 1923 are:

President, Anton J. Carlson, University of Chicago.

Secretary, Charles W. Greene, University of Missouri.

Treasurer, Joseph Erlanger, Washington University, St. Louis.

Arnold B. Luckhardt, University of Chicago, and John R. Murlin, University of Rochester, were elected to membership in the council of the society.

The following resolutions were presented and voted by the society:

Resolved: That the American Physiological Society strongly approves the full international character of the Physiological Congress at Edinburgh, and that we heartily support the efforts of the organization committee in that attitude.

Resolved: That the Physiological Society extend an invitation to the International Physiological Congress of 1926 to meet in America.

Resolved: That the American Physiological Society express to the local committee and especially to its chairman, Dr. Henderson, their appreciation of the excellent management of the meetings and of the delightful entertainment provided, which place the Toronto meeting among the most successful and enjoyable in the history of the society.

SCIENTIFIC PROGRAM

The topics rendered in the scientific program are completely listed below:

The significance of the dual function of hemoglobin in relation to the mechanism of the chemical regulation of respiration: Robert Gesell, Washington University, St. Louis.

Circulatory changes in experimental dehydration: N. M. Keith, Mayo Foundation.

The effect of anoxemia on metabolism: E. J. Koehler (by invitation), E. H. Brunquist (by invitation), and A. S. Loevenhart, University of Wisconsin.

Some effects of strychnine and physostigmine upon the blood picture: C. W. Edmunds and Putnam C. Lloyd (by invitation), University of Michigan.

On the existence of a hitherto unknown nutritive factor essential for reproduction: H. N. Evans and K. Scott Bishop (by invitation), University of California.

A comparison of the effects of the injection of gum acacia solution and of the transfusion of blood on the oxidative power of the brain as indicated by alterations in temperature after the injection of adrenalin: George W. Crile, Amy F. Rowland (by invitation), and S. W. Wallace (by invitation), Cleveland Clinic.

The respiratory quotient and basal metabolism following removal of the liver and glucose injection: F. C. Mann, Mayo Foundation.

On the physical properties, daily amount and rate of secretion of human pancreatic juice: A. B. Luckhardt, Fred Stangl (by invitation), and F. C. Koch (by invitation), University of Chicago.

Respiratory exchange studies under ether narcosis: T. K. Kruse, University of Pittsburgh.

The basal metabolism of girls from eleven to fourteen years of age: Mary Swartz Rose and Grace MacLeod (by invitation), Teachers College, Columbia University.

On the local reflex mechanism and the nature of the segmental contractions in the small intestine: Albert Kuntz (by invitation), and J. Earl Thomas (by invitation), St. Louis University.

Electrical conductivity of living tissues as affected by the surrounding medium: S. C. Brooks (by invitation), Washington, D. C.

Some X-ray studies on the heart: W. J. Meek and J. A. E. Eyster, University of Wisconsin.

The physiological action of ionizing radiations: Alfred C. Redfield, Harvard Medical School.

On the cause of the initial rise in the basal metabolic rate during fasting: Margaret Kunde (by invitation), Chicago.

Influence of gonad hormones on the seminal vesicles: N. F. Fisher (by invitation), Chicago.

Effect of muscular activity on perfused adrenin: R. G. Hoskins and E. P. Durrant (by invitation), Ohio State University.

Effect of digestive enzymes on pituitary extract action: Maurice H. Rees (by invitation) and Richard Whitehead (by invitation), University of Colorado.

Neuro-muscular activity in cretinoid sheep: Sutherland Simpson and Howard S. Liddell (by invitation), Cornell University.

The cost of work in exophthalmic goiter: H. S. Plummer (by invitation) and W. M. Boothby, Mayo Foundation.

The effect of thyro-parathyroidectomy and parathyroidectomy at 100 *days of age on the growth of male albino rats:* F. S. Hammett, Wistar Institute.

The pathogenesis of parathyroid tetany: L. R. Dragstedt, University of Chicago.

The control and cure of parathyroid tetany: A. B. Luckhardt, P. Rosenbloom (by invitation), J. Blumenstock (by invitation), and B. Goldberg (by invitation), University of Chicago.

Increase in size at moulting: J. P. Baumberger and J. M. D. Olmsted, Stanford University.

The calorigenic action of adrenalin chloride: W. M. Boothby and I. Sandiford (by invitation), Mayo Foundation.

The supposed relation of the adrenals to reflex volume changes in the denervated limb. (Lantern): G. N. Stewart and J. M. Rogoff, Western Reserve University.

The supposed relation of the adrenals to the blood-pressure changes induced by cerebral anemia. (Lantern): J. M. Rogoff and Helen C. Coombs, Western Reserve University and Columbia University.

Retinal mean local sign; a new view of the relation of the retinal mosaic to visual perception: F. W. Weymouth, Emelie E. Anderson (by invitation) and H. L. Averill (by invitation), Stanford University.

Chemical effects produced by passing electric currents through thin artificial membranes of high electrical resistance: R. S. Lillie and S. E. Pond (by invitation), Nela Research Laboratory.

Some physiological effects of saccharin: A. J. Carlson, University of Chicago.

Delay in the response to the second of two stimuli in nerve, and in the nerve-muscle preparation: Alexander Forbes, F. R. Griffith (by invitation) and L. H. Ray (by invitation), Harvard Medical School.

Some characteristics of the action current in nerve: Herbert S. Gasser and Joseph Erlanger, Washington University, St. Louis.

Rapid intestinal absorption, without digestion, of a complex protein substance—tissue fibrinogen: C. A. Mills, University of Cincinnati.

The effect of formaldehyde upon the vitamin content of milk: A. M. Bleile and R. J. Seymour (by invitation), Ohio State University.

The excitation of gastric secretion by application of substances to the duodenal mucosa: A. C. Ivy and G. B. McIlvain (by invitation), Loyola University.

The behavior of the empty stomach in the mollusca: T. L. Patterson, Detroit College of Medicine and Surgery.

Study of pulse wave velocity in arteriosclerosis: Jane Sands (by invitation), University of Pennsylvania.

The all-or-none character of minimal flexion reflex contractions in the spinal cord: E. L. Porter, Western Reserve University.

The influence of insomnia, fasting, etc., on the kneejerk: Mary A. M. Haupt (by invitation) and N. Kleitman (by invitation).

Experiments on the mechanism of action of insulin: J. J. R. Macleod, N. A. McCormick (by invitation), E. C. Noble (by invitation) and K. O'Brien (by invitation), University of Toronto.

Quantitative parallelism of effect of insulin in man, dog, rabbit: F. H. Banting (by invitation), C. H. Best (by invitation), G. M. Dobbin (by invitation) and J. A. Gilchrist (by invitation), University of Toronto.

Delayed manifestation of the physiological effects of insulin following the administration of certain pancreatic extracts: J. B. Collip, University of Alberta.

Methods of administration of insulin: F. G. Banting (by invitation), G. M. Dobbin (by invitation) and Miss S. Cairns (by invitation), University of Toronto.

Methods of administration of pancreatic extracts to diabetic animals and man: C. Clyde Sutter (by invitation), C. B. F. Gibbs (by invitation) and John R. Murlin, University of Rochester.

The physiological assay of insulin: G. S. Eadie (by invitation), N. A. McCormick (by invitation), Miss K. O'Brien (by invitation) and J. J. R. Macleod, University of Toronto.

The effect of voluntary contractions and of dermography on the number of visible capillaries of the human skin: G. N. Tsang, University of Minnesota.

PAPERS BY TITLE

Measurement of the circulation rate in man: H. W. Haggard and Y. Henderson, Yale University.

On Weichardt's supposed fatigue toxin: Frederic S. Lee and B. Aronovitch (by invitation), Columbia University.

The chemical regulation of the activities of the human kidney: E. F. Adolph, University of Pittsburgh.

Some conditions determining adrenal secretion:

F. A. HARTMAN, University of Buffalo.

Some effects of adrenalin on the perfused bullfrog heart: C. I. REED (by invitation), University of Kansas.

On the concentration of proteins in tissues: E. J. COHN, Harvard University.

The site of the anaphylactic reaction of the uterus: O. O. STOLAND, University of Kansas.

Certain factors affecting filtration through berkefeld candles: STUART MUDD, Harvard University.

Some effects of various environmental temperatures upon the blood of dogs: E. L. SCOTT and F. B. FLINN (by invitation), Columbia University.

Causation of the differential blood pressure in aortic regurgitation: H. C. BAZETT, University of Pennsylvania.

Bio-physical studies of the effects of adrenalin upon the temperature of the brain and of other organs and tissues: GEORGE W. CRILE and HUGO FRICKE (by invitation), Cleveland Clinic.

The motile state of the stomach of the monkey in hunger: T. L. PATTERSON and JESSIE ILLENDEN (by invitation), Detroit College of Medicine and Surgery.

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THE LIFE CYCLE OF THE PROTOZOA[1]

THE obligation which this occasion brings offers a challenge to the zoologist whose pleasant privilege it is to address you, to summon from his experience his ripest judgment upon the problems of greatest interest in his field of investigation. It affords him the opportunity to round up his vagrant ideas, to corral his scattered observations and to brand them with the symbols which we all recognize. He must therefore leave the specialized field in which he ranges and come into the arena of our common and central problems.

The Protozoa, according to our generally accepted view of the evolution of the animal kingdom, stands at the base of the animal tree of life. From them have sprung, perhaps in a polyphyletic fashion, the other phyla. The structure of the collar cells of the Porifera suggests the origin of this phylum from the Choanoflagellata. The occurrence of nematocysts, tentacles and eyespots in the Dinoflagellata turns our attention from them to the Cœlenterata, while some ciliates and the platyhelminthes have much in common. Be this as it may, the Protozoa are found in the oldest fossiliferous rocks, and the genera of Radiolaria therein conform rather closely to genera living to-day, while the fossil Dinoflagellata of the flints of Delitzsch are scarcely distinguishable from species living in the modern seas. The striking similarities of the most ancient fossil Protozoa to recent ones afford some ground for the inference that the Protozoa living to-day differ but little from those when life was young. We may therefore turn to this group with some confidence that the phenomena which we discover therein to-day are both significant and instructive as to form, structure and function, when the waters of the primitive seas formed the first balanced aquarium.

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[1] Vice-presidential address before Section F—Zoology of the American Association for the Advancement of Science and presidential address before the American Society of Zoologists at Boston, December 27, 1922.

The Protozoa appear to have emerged at that level in the evolution of living substances in which the nucleus was being established, superseding the phase of distributed chromatin and substituting a permanent organization of chromatin within a nuclear membrane for the temporary aggregation of chromatin granules at certain critical stages in the life cycle, such as division. While it is as yet too early in the period of the cytological exploration of the Protozoa to conclude that the evolution of chromosomes first took place in this group of animals, it does seem highly probable that this is true and quite probable that most Protozoa have definite nuclei and that they have chromosomes and that they conform in principle to the basic features of mitosis in the Metazoa and Metaphyta.

The seeming exceptions to this conclusion which we find in accounts of the *de novo* origin of nuclei from chromidia lack adequate cytological evidence and are in my opinion based upon false interpretations of cytoplasmic contents and conditions resulting from the cycle of metabolism in part, and, in a few reported instances, are based upon undetected parasitic infections. Our confidence in the conformity of the Protozoa to the integrity of and descent of nuclei and in the individuality of chromosomes which we find in the Metazoa, increases steadily as sound cytological investigation of the group progresses. We may therefore infer that the Protozoa have a cellular organization and are equipped with the essential structural basis for the mechanism of heredity, in so far at least as the possession of chromosomes, mitosis and even chromomeres and also genes are concerned.

With the presence of this equipment established in the group we may well ask in how far these supposedly simple organisms have also taken on the complicated life history of the Metazoa and Metaphyta. It is to several aspects of this question that we will turn our attention more closely this evening.

The searcher for the origins of biological phenomena will find the Protozoa a fertile but perplexing field for their discovery. Here have arisen all the fundamental types of symmetry, spiral, both leiotropic and dexiotropic, radial, bilateral and a host of modifications of these. *Here also are several distinct types of mitosis, different locations of the centrosome, extraordinary derivatives of this organ ranging from* the nematocysts of the dinoflagellates to the complicated neuromotor systems of the trichonoymphid flagellates. Sex and sexual dimorphism, ranging from slightly different staining reactions between gametocytes to profound sexual dimorphism of gametes, have had their origin here. The Protozoa have provided the arena in which the primitive pageant of life made its first parade before it settled down into the more humdrum and less interesting mediocrity of metazoan and metaphytic conformity.

Let us then turn to the fundamental problem of the life cycle. Within the phylum of the Protozoa there have been evolved certain developmental processes which seem to have a rather precise correspondence with processes which constitute the fundamental parts of the life cycle of the Metazoa. These have attained their fullest development only in the highest representatives within the several classes of Protozoa, such as the ciliates, flagellates, Sarcodina and Sporozoa. They appear to have evolved independently in the several groups. Their origin thus seems to be polyphyletic. These points of agreement are:

1. The elaboration of the mechanism of heredity up to the point of nuclei with chromosomes whose individuality, continuity and diversification appear to be comparable with that attained in the metazoan nuclei.

2. The development of sex, of sexual reproduction—perhaps of the sex complex of chromosomes, and coincident with these the phenomena of gametogenesis and fertilization comparable in essentials of chromosome individuality and segregation with the conditions in the Metazoa.

3. The universal occurrence of the phenomenon of asexual reproduction, not to be confused with the attendant phenomenon of mitosis of unicellular organisms. Mitosis is important because of the unicellular state in some Protozoa.

4. The development of a multicellular stage following fertilization or following its possible equivalent; this multicellular stage I shall

designate as a somatella. In it there is generally no progress to the point of division of labor and differentiation of tissues, although the differentiation of sexual and somatic cells occurs in some instances, as in *Paramœcium* and *Volvox* and in the pansporoblast of the Sporozoa, and histological differentiation of the somatic cells is clearly arrived at also in the pansporoblast.

5. The occurrence of death as a biological phenomenon as normal to the Protozoa as it is to the Metazoa.

In addition to these unifying features which tend to bring into one biological scheme the Metazoa and the higher Protozoa, we have the outstanding fact to which biological thinking of the time has given too little attention; namely, that in many, possibly most, of the species of most of the Protozoa, and indeed in the still wider group of the Protista as well, sexual reproduction has never been found and probably does not occur in some species in which it has been reported. Nevertheless, there prevails among these primitive organisms the phenomenon of evolutionary divergence, or speciation, and the origin of specific distinctions. These distinctions seem to be indistinguishable in scope and kind from those of the Metazoa when tested by genetic studies, by morphological and cytological analyses, and by the more precise refinements of biochemical relations as revealed in serological reactions. Let us now turn to a fuller consideration of these points which I have enumerated as having been evolved in the group of Protozoa.

Prior to taking these up let us remind ourselves of the fundamentals of the life cycle of the living substance which constitutes so important a feature of this aggregate of matter and energy as over against that which constitutes the non-living world. The essential elements of such a cycle, be it in the plant or animal, in the Protozoa or the Metazoa, the Protophyta or the Metaphyta, appear to be the following:

We begin the cycle with the zygote, carrying two sets of ancestral genes contributed to the individual by the haploid gametes, thus establishing a diploid state in the individual. This diploid condition of the nucleus of the zygote is then transmitted to all nuclei of all cells of the subsequent subdivisions of the zygote until segregation takes place in gametogenesis.

The interaction between nuclei containing these genes and the cytoplasm in which they are found presumably controls by chemical action the subsequent processes of growth and differentiation and thus determines the volume and nature of new cytoplasm and its contents and the rate of its production. This control persists throughout the whole of the life of the zygote and of all of its subdivisions. We may designate the sum total of living substance thus controlled in all of the succession of functional individuals as the zygotic or Huxleyan individual.

The first step in the development of the zygote is cleavage and the formation of a multicellular complex which, in higher forms, becomes differentiated by histogenesis and organogenesis into complex and specialized organs of the individual.

The subdivision of the zygotic individual into varying numbers of functioning individuals by various processes of asexual reproduction is made possible by the persistence of undifferentiated tissues or by processes of dedifferentiation. The initial genetic equipment of the zygote thus continues its control throughout the life of all of these subdivisions resulting from asexual reproduction of different patterns. The genetic type of organization established by the fusion of the gametes maintains its integrity throughout this process, although the various bodies which may carry it yield to the assaults of the environment.

The universality of this phenomenon of asexual reproduction is one of the striking features of the living substance, especially in the Protozoa, where we see it manifested in binary and in multiple fission and sporulation of various types. We find it in the Metazoa in the budding processes of hydroids and medusæ, transverse segmentations of planaria and of the strobila of the tapeworm, in the various types of gemmules, statoblasts and brown bodies of Bryozoa, in the embryonic fission of midges and of the armadillo, and in identical twins in man. It may also appear in teratomata and embryomata of vertebrates and perhaps bears some relation to the potentialities of the living substance to afflict itself with malign neoplasms. The fact seems to be that the living substance of the individual is constitutionally unable, even in its highest levels of evolution, to wholly shake off the deeply rooted tendency to reproduce others of its kind or other kinds, or to give rise to some other phase of a life cycle by some form of asexual reproduction. Broadly viewed, the whole evolutionary process in plants and animals appears to have progressed by the suppression of asexual reproduction and increasing emphasis on the differentiation of the body of the zygote as first produced.

It is therefore perhaps not without significance that the process of asexual reproduction is so deeply entrenched among the protists and antedates, in the process of evolution, the origin of sexual reproduction itself. In spite, however, of this tendency for the multiplication of functional units by the process of asexual reproduction, we find that the living substance sooner or later arrives at a stage both in ontogeny and in phylogeny in which gametogenesis ensues and by this method provision is made for the origin of new life cycles, starting with a variety of types limited only by the possible permutations in the ancestral genes and the viability and survival values of these combinations. With the accomplishment of gametogenesis the processes of senescence are hastened and the death of the individual or individuals ensues. We may summarize, then, the essential features of the life cycle as syngamy, or sexual reproduction; cleavage of the zygote; histogenesis and organogenesis and the division of labor; asexual reproduction resulting in the multiplication of functioning individuals; gametogenesis; senescence and death.

There has been a tendency in some quarters to set aside the Protozoa, as exempt from the program involved in this life cycle as manifested in the Metazoa and Metaphyta. Indeed, some have even denied the cellular character of the Protozoa while others have intimated that the phenomenon of heredity was of necessity of a different type in this primitive group and even that the Protozoa are immortal. In addition to these restrictions on the point of view there have arisen in the course of the investigations of the Protozoa certain interpretations of the developmental phenomena discovered therein which seem to militate against the possibility of the existence of one or other of these fundamental stages of the life cycle. Let us therefore turn to the Protozoa and consider in some detail in how far, in reality, they tend to conform to the common scheme of the life cycle which has been so widely adopted and prevails so universally in the Metazoa and the Metaphyta.

The first point to which our attention is turned is naturally the existence of the mechanism of heredity in the Protozoa. We are confronted at once by the statement that the Protozoa are not purely cellular; they are rather organisms. This question appears, however, to be purely a formal one and is met by the definition of a cell from the dynamic point of view, to wit: that a cell is not only a nucleus with a surrounding cytoplasm, but that it is also a chemical engine for the flux of matter and the flow of energy. Cell boundaries are not essentially a part of the definition of a cell. From the dynamic point of view the Protozoan is as surely a cell or a group of cells as is an egg or a blastula, or a man. The fact that it is also a complete organism within, it may be, the confines of one cell, merely complicates its structure by necessitating in many Protozoa the existence, within the cytoplasmic domain of a single nucleus, the presence of the organelles of the individual and the performance of the several different functions of life within the boundaries of the one domain. It is apparent to one who scans the widespread occurrence of multicellular states among the Protozoa that it is clearly a matter of entire indifference to the functional efficiency of the Protozoan as to how many cells there may be in its make-up. It is more a matter of importance that the quantity of the nuclear and cytoplasmic substances should be properly adjusted to each other and to the volume of matter and amount of energy in the process of transformation. There is such a suitable adjustment which Hertwig has long since emphasized which finds many illustrations in any comparative study of any considerable group of Protozoa. A huge radiolarian with the enormously complex skeletal structure composed of thousands of elements integrated in a common and complex pattern may have a single nucleus of huge dimensions with as many as 1,600 chromosomes. Two species of flagellates living in the same environment in the digestive tract of a termite may have in one instance a single large nucleus with its attendant intricate neuromotor system of many complex elements, while the other of approximately the same size may have 2, 4, 8, or it may be 50 nuclei. But these will have in a general way a correspondingly small quantity of chromatin in each nucleus and the total in all of the nuclei will approximate in quantity that in the single nucleus of the accompanying species of like size.

Our conceptions of the nucleus in Protozoa have been thrown into confusion and to some extent therefore excluded from the category of metazoan and metaphytan nuclei by the accounts of protozoologists of the occurrence among Protozoa of certain cytological phenomena which appear to undermine and to render impossible our modern concepts of the mechanism of heredity in that they seem to invalidate the continuity and individuality of the chromosomes.

The complicating concepts are; namely, the occurrence of amitosis, of the formation of nuclei *de novo* from chromidia; chromidiogamy or the formation of gametes from chromidia; and of multiple nuclear division, in which a single nucleus parts at once into numerous nuclei. Added to this group of perplexing phenomena is the persistent proposal that Protozoa reproduce by the process of autogamy emanating from the Schaudinn-Hartmann school at Berlin and its followers.

Without attempting at this time to go into the cytological details necessary to refute any or all of these seemingly unusual and complicating cytological phenomena, I will pass them by with the statement that in the course of more than ten years of intensive work on the cytological processes of flagellates and rhizopods, I have been wholly unable to find any satisfactory cytological evidence to support any view that the nuclear phenomena of the Protozoa differ fundamentally from those of the Metazoa.

In the first place amitosis as described in the Protozoa is either a pathological or degenerative process, as it is in the Metazoa, or it is based on a partial account of the normal process of mitosis in which the nuclear membrane remains intact throughout the whole process, as it does in flagellates and rhizopods, and in its anaphases presents a superficial resemblance to pathological amitosis. The persistence of the nuclear membrane in no way interferes with the occurrence of chromosomes constant in number and kind. In other words, the doctrine of chromosome continuity, insofar as amitosis is concerned, is no more affected in the Protozoa than it is in the Metazoa.

We have had accounts of the *de novo* origin of nuclei and of chromidiogamy by an association of chromidia in the cytoplasm into new nuclei while at the same time the old nuclei disappear. These accounts of this process in *Arcella, Actinosphærium,* and in certain flagellates are, in our observation, the results of the failure to apprehend the fact that the process of metabolism in the protozoan individual brings about in the protozoan cell the formation of intracytoplasmic substances which, on the one hand, provide for the rapid multiplication of cells, as does the yolk of the egg after fertilization, and, on the other hand, obscure, by the very fact of their stainability, the actual process of mitosis in nuclei. The observer is led to give a false interpretation of degeneration to the condition in which the nucleus of the protozoan fades as a result of the process of metabolism, not unlike that in the growing egg during yolk formation. In this process it loses much of its stainability, appears to be degenerated and is hidden in the mass of stainable substance, the so-called chromidia, in the cytoplasm. It then undergoes rapidly a succession of cell divisions, during which period the chromidia are reduced in mass, the new nuclei show increased stainability, but the observer has mistakenly attributed their origin to the disappearing chromidia.

The *de novo* origin of nuclei in *Amœba proteus* described recently by Carter is, we believe, entirely of this nature. Similar accounts of *de novo* formation of nuclei and of chromidiogamy in *Arcella* appear to me to be of a similar nature, and it is possible there is also a confusion here by some investigators of moribund stages of individuals and of parasitized individuals. Some instances of the *de novo* origin of nuclei in flagellates appear to be instances of parasitism rather than *de novo* origin.

In like manner some at least of the so-called cases of multiple nuclear division are to be attributed to a process of rapid mitosis rather than multiple, coincident fragmentation of a single nucleus. In any event, the cytological evidence upon which the processes of chromidial organization of nuclei, chromidiogamy and multiple nuclear division are based are undoubtedly wholly inadequate to establish the occurrence in the Protozoa of these biological processes so fundamentally unusual and so subversive to the more adequately founded concept of the mechanism of heredity. It appears that they should be dismissed entirely as wholly unproven in fact and be regarded as inadequate interpretations of other processes, normal, pathological or parasitic in nature.

The occurrence of autogamy in the Protozoa presents far less theoretical difficulties. Its incorporation in any system of interpretation of the operation of the mechanism of heredity involves no greater difficulties than does hermaphroditism and self-fertilization in the cestode or cleistogamy in the violet. The main difference lies in the fact that owing to the small size and limited number of cells in the protozoan cycle the uniting autogamous gametes are genetically nearer their common cellular ancestor than they are in the tapeworm or the violet. Some, however, of the processes of autogamy, as, for example, that of *Endamœba coli*, described by Schaudinn and by some other investigators in the parasitic Protozoa, rest upon misinterpretations of the process of cleavage in the encysted organism, and upon the mixture by investigators of the life cycles of several different parasites as parts of the cycle of one. We may conclude, then, that insofar as the fundamental nature of nucleus, chromosomes and mitosis is concerned, Protozoa conform in essential features to the nuclear mechanism of the Metazoa and that autogamy, if present, is not peculiar to Protozoa and offers no serious obstacle to the modern conception of the mechanism of heredity.

The existence of sexual phenomena in the Protozoa has been a matter of frequent record and of repeated observation in various types of Protozoa. It was the result not only of the brilliant series of interpretative papers by Schaudinn, foremost leader in modern protozoology, but also of those by his many followers. In a series of brilliantly conceived, rapidly developed and handsomely illustrated monographs, Schaudinn demonstrated the existence of sexual reproduction as a part of an elaborate life cycle in a series of Protozoa from rhizopods to the malarial parasite, thus giving rise to the general belief that sexual reproduction was probably universal in the Protozoa and that it was only a question of skillful interpretation and fortunately selected material for any investigator to be able to demonstrate its occurrence in any species of the group.

Some doubt has arisen as to the validity of some of Schaudinn's conclusions, and doubt also as to the accuracy of some of his observations. This has arisen in part from his well-known mistakes in his account of the life cycle of the trypanosomes in which he confused in one life cycle those of no less than three different organisms. The elaborate and critical work of Minchin and of others who have worked with trypanosomes has failed in the slightest to confirm Schaudinn's conception of the sexual reproduction of these organisms.

It would not be fitting for one to pass criticism on any of the other accounts which this investigator has given us unless one had himself painstakingly worked over similar material. I wish to take this occasion, however, to state that prolonged research with the protomonad, polymastigote, dinoflagellate and euglenoid orders of the Mastigophora and in the Rhizopoda during the past ten years by my collaborators, students and myself has thus far failed to give us the slightest critical evidence of the occurrence of sexual reproduction in any of these orders. It is possible to find in one's material and to picture, as Goldschmidt and others have done, a sequence of fixed and stained stages which will simulate, in the most striking degree, the successive steps in the process of sexual reproduction if one neglects chromosomes. But over against these facts one must place his observations that dividing flagellates may within the brief time of a single minute assume positions simulating in their space relations final stages of plasmotomy and to exhibit later the appearance of the initial stages of conjugation owing to the great facility with which the neuromotor organelles shift the positions of the parting sister cells. One should, therefore, utilize such material with utmost caution. Throughout all of our work we have failed to find in the groups named the least evidence of gametogenesis and of syngamy based upon cytological evidence involving chromosome number and behavior. We are, therefore, highly skeptical of all accounts of sexual reproduction in the flagellates other than those in the Volvocidæ, where differentiated gametes, as in the case of *Volvox,* occur.

In the same way our recent investigations in the mitotic process occurring in the cysts of intestinal rhizopods leads us to reject entirely Schaudinn's account of sexual reproduction in this group, and has increased our skepticism in the account of its occurrence in the free-living rhizopods. It is a matter of prime consequence that protozoologists and others accept no account of sexual reproduction as adequately established which does not rest upon essential cytological features of gametogenesis and fertilization, and the clear cut, unquestionable establishment of the haploid and diploid sequence in these processes.

The seeming absence of sexual reproduction in the bacteria and in many of the protophytes combined with its seeming absence in the lower Protozoa does not militate against the fact of its establishment in the higher forms, but does bring us face to face with the fact that it is probably within the group of Protozoa and perhaps independently in its several orders that the phenomenon of sexual reproduction has had its evolutionary origin. Insofar as this fact bears upon our thesis that the life cycle of the Protozoa and the Metazoa are essentially similar we should have to admit that the similarity inheres only in the higher representatives of the several orders of the Protozoa, or at the most in the Sporozoa and Ciliata and in a number of species perhaps of the other orders.

This conclusion, if true, brings us to a consideration of the possibility that there may occur also in these primitive forms which now represent the earlier steps of the evolutionary process of the phenomenon of reproduction a periodic nuclear reorganization of the genes that is not primarily sexual. In its morphological features and in its relationship to the permutations of genes and to their origin in the life cycle such reorganization may play a part in the mechanism of heredity not unlike that accomplished by the phenomenon of sexual reproduction in the Metazoa. Whether there is such a nuclear phenomenon and the manner in which it operates are both matters upon which we have as yet little or no light. The phenomenon of endomixis appears to be somewhat more like that of parthenogenesis than a more primitive form of nuclear reorganization. In the absence of full knowledge of the behavior of chromosomes during endomixis in *Paramœcium* and other ciliates final judgment must be suspended as to the identity of endomixis and parthenogenesis.

It is an undeniable fact that in the Metazoa and Metaphyta the gametocytes go through a long period within which cell division is suspended and metabolic and histogenetic processes of considerable importance in the development of the egg and sperm proceed within and without the nucleus of the cell; thus, for example, the oocyte acquires its load of yolk and the spermatocyte prepares for the elaborate histogenesis of the resulting gamete. It is during this period of suspended mitotic activity that synapsis and cross-over which makes possible the segregation and new alignments of genes take place.

Let us also remind ourselves that following activation by fertilization, the egg, by reason of its food reserve in yolk, proceeds at once with a series of rapidly succeeding cell divisions. This phenomenon of cleavage is fundamentally and essentially similar in all Metazoa and Metaphyta. It is therefore unquestionably a fundamental phenomenon of the living substance, but it appears in these groups to be a consequence of the activation resulting from fertilization or its equivalent. This equivalent is found in some cases in the stimulation of ova to development by mechanical, chemical or physical external stimuli. These facts suffice to raise the query in our minds as to whether or not sexual reproduction is absolutely an essential feature even in those organisms in which the process of evolution proceeds by periodic reorganization of the genetic constitution by syngamy. Might it not be possible that there is a process in primitive organisms even more fundamental than sexual reproduction, in which the genes of the chromosomes are subjected to periodic readjustments of an unknown kind during a period prior to the occurrence of renewed mitotic activity?

This inquiry directs our attention to the fact that in those Protozoa in which sexual reproduction does not occur, or at least has never been found, there occurs nevertheless the same type of periodic rest found in gametocytes followed by rapid cell division, resulting in the formation of a temporary somatella similar to that which is found following activation resulting from fertilization. I refer to the period of encystment so frequent in Protozoa which occurs in the presence of an abundance of food and appears to be primarily a cessation of motility, a period of elaboration of reserve food, and is followed by a period of rapid cell division.

Our attention has already been directed to the fact in the life cycle of human intestinal Protozoa. During our prolonged search among the encysted phases of these organisms for evidences of maturation and fertilization we have been wholly unable to detect the least traces of any critical evidence of the occurrence of either of these processes. We do find, however, that all of the six species known in man and some of the flagellates also found in human stools tend to encyst, and then to proceed with rapid cell division, building up a 4-, 8-, 16- or more-celled body within the cyst. Free living rhizopods and flagellates are known to exhibit the same phenomena.

The successive steps in this process are well illustrated in the species *Councilmania lafleuri*, the largest of the amœbæ of man. This amœba, which in its active stage feeds upon bacteria, red blood corpuscles and on the active and encysted stages of other protozoan parasites of man, prepares for encystment by the ejection of the contents of its food vacuoles and consequent reduction in volume. It then seals itself within an extraordinarily impervious membrane or cyst wall and immediately elaborates within the substance of its cytoplasm a centrally located and relatively very large glycogen vacuole. This substance exhibits the typical reactions to iodine and to Best's carmine which characterize the glycogen of mammalian cells. This glycogen vacuole may fill as much as one half or more of the volume of the cyst. It crowds the nucleus into the peripheral cytoplasm. Unfortunately, owing to lack of material, we have been unable to get at the nuclear modifications during this earliest phase by careful cytological studies. The stages available for examination have been mainly those subsequent to the formation of the glycogen. The nuclei during this period of greatest glycogen abundance are often very much enlarged and the chromatin which is usually gathered in the central karyosome may be spread out in expanded, greatly elaborated condition. The next step in the process is an elaboration within the outer cytoplasmic film and in immediate contiguity to the glycogen of numerous small chips or splinter-like chromatoidal bodies. As these increase in number the glycogen diminishes in volume until ultimately it entirely disappears. During the period of its decrease and the origin of these chromatoidal bodies, the nuclei begin their mitotic divisions, and generally proceed through the first and second of these divisions. When the glycogen has entirely disappeared, the chromatoidal bodies are generally found in a bundle lying near the center of the cyst, and reaching nearly from side to side. This cluster of bodies stains intensively with hæmatoxylin and may be the most prominent feature within the cytoplasm.

In the meantime the nuclei have passed through a third and fourth mitosis, resulting in 8 and 16 nuclei within the cytoplasm. At the termination of this process there then ensues a peculiar form of growth in which the 16-nucleated somatella which shows absolutely no trace of subdivisions proceeds to give rise to a series of budding amœbulæ which one after another are dropped off from the parent mass. This process bears a peculiar and significant relationship to the substance elaborated in the chromatoidal bundle and takes place with special reference to its location within the cyst.

In the first place a definite and minute pore is opened through the cyst wall directly opposite one end of the chromatoidal bundle. Prior to the opening of this pore there generally appears in the periphery of the cytoplasm a well-marked deeply staining strand of material in the form of a single arc or of a tripartite one. The substance of these structures is deeply chromophile and is even directly continuous with the end of the chromatoidal bundle which appears to be reduced gradually in volume as the ridges are formed and the amœbulæ emerge. The chromophile substance from the ridges and from the end of the chromatoidal body seems to be drawn upon definitely by the cytoplasm emerging from the pore into the bud, so that the buds are noticeably more deeply stained than the cytoplasm of the parent somatella, and to correspond in stainability to the chromophile substance which antedates in its formation their emergence. Generally at some time before the budding process is completed the entire amount of chromophile material in the chromatoidal bodies entirely disappears.

The sequence of events within the cyst involving elaboration of glycogen and its disappearance, the formation of the chromatoidal substance and its relation to the growth processes, are suggestive of the sequence in the egg and the relationship of specific yolk substances to cleavage and differentiation in the metazoan egg.

It is obvious to one who studies the process of encystment so widely prevalent among the Protozoa that this feature of their life is not merely a device for survival during periods of drought and a means of protection which favors dispersal of the species into new localities. The process occurs in the presence of abundance of food and appears to be more clearly related to metabolism than to any protective necessity or impending danger of desiccation. It is certainly useful as a means for survival, but its origin and primary function appear to be fundamentally metabolic and related to growth. In view of this fact and of its intimate relationship to rapid mitosis and the formation of a multicellular body, one is led to infer that the period during which the glycogen is elaborated is one of profound cytological significance and one, perhaps, in which it may be possible for a nuclear reorganization to take place. Moreover, it may be that this is a reorganization of the genetic complex of its chromosomes. It is on this point precisely that we lack any cytological evidence at present. It is, however, to this period in the life cycle that I wish to direct the attention of protozoologists, geneticists and cytologists, with the hope that some one may find an organism in which this stage may be studied to advantage, because of the size of the nucleus, number of chromosomes, and ease of control of material.

Certain features of the protozoan nucleus appear to lend support to the possibility that there may be a more fundamental and primitive form of nuclear reorganization than that which sexual reproduction offers. These features are: first, the fact that in some flagellates only a relatively very small amount of the chromatin within the nucleus takes part in mitosis. In the second place, there appears in nuclei of the dinoflagellates to be a persistent organization of beaded chromosomes with subparallel or even spiral arrangements within the nucleus. This parallelism (though not synaptic) might offer a basis for cross-over, or its equivalent, during a period of syniezesis. Should such a phase in the cycle of the cell make possible such reorganization, we might find in them a mechanism for genetic modifications. The consequence of such permutations of the genetic substance might not be unlike those resulting from synapsis in sexual reproduction and thus provide for evolution in the absence of syngamy.

In this connection attention should be directed to the findings of Jameson upon the exact location in the life cycle of the period at which maturation occurs in the Sporozoa studied by him. He has found that reduction division follows immediately upon fertilization with the result that the haploid condition in these Protozoa persists throughout the natural period of growth and recurrent asexual reproductions which prevail during the life of the parasite within the host, while the diploid lasts but one cell generation. It thus appears that while in the Metazoa the haploid condition of the organism is limited to the second maturation division only of the spermatocytes and oocytes of the second order and thus to a very brief period in the total life cycle, in some Protozoa this diploid-haploid relationship may be reversed in relative duration.

In the light of the fact that many of the Protozoa appear to have no sexual reproduction, and yet nevertheless to have accomplished an evolutionary progress of no small magnitude, these observations of Jameson are significant. They lend weight to the possibility that sexual reproduction originates within the Protozoa, and, as in some of the cryptogams, establishes a diploid condition controlling only a part and apparently only a very small part of the prolonged life cycle. It gives us occasion to consider whether or not sexual reproduction may not have been elaborated gradually and independently within different groups in the Protista, and subsequently in them and in higher forms of life the diploid state has extended its domain more and more throughout the life cycle of the organism. Indeed, the very fact that the Protozoa run with a six cylinder instead of a twelve cylinder engine, granting the universality of Jameson's observations for the sake of argument, may be the very reason why they have not been successful in building up a differentiated body. They run the multicellular part of their course with only a brief-lived and relatively inefficient somatella instead of a specialized soma.

It was stated in the introduction to this discussion that the Protozoa are multicellular as truly as the Metazoa. The difference between Protozoa and Metazoa lies not in the fact of occurrence, but in the degree to which multicellularity progresses. In the Protozoa the multicellular phase which results from cleavage is limited to few mitoses and small number of cells. In amœbæ, as far as we at present know, it does not get beyond a sixteen-celled stage. In most flagellates eight seems to be the stopping point. In *Paramœcium* likewise the eight-celled stage is the limit of the development of the somatella.

Furthermore, the length of life of the individual in the multicellular phase is generally a brief one, for example, the sixteen-cell stage of *Councilmania* proceeds rather quickly to asexual reproduction by budding, and in the most of the polymastigote flagellates the eight-celled somatella rather quickly disappears by successive plasmotomy into unicellular units. However, in both of these classes of Protozoa there are multicellular species which live for prolonged periods in the multicellular phase, as, for example, in the Foraminifera, in the pansporoblasts of the Sporozoa, in the colonial Volvocidæ, in some polymastigotes, and in not a few of the ciliates.

Some of the somatellas of the Protozoa proceed in the direction of histogenesis and the division of labor by the segregation of sexual and somatic cells, as, for example, in some of the Volvocidæ where the gametocytes form only a part of the body or in the pansporoblast of the sporozoans in which we have one or two sex cells enclosed within a body of four or more other cells and the body itself may be differentiated into cells of two kinds. In the case of the ciliates, we find, as in *Paramœcium,* the eight-cell stage of the somatella formed by cleavage differentiated into four somatic nuclei and four sexual nuclei—three of which degenerate, and the body thus formed proceeds by asexual reproduction to reduce the number of nuclei to the normal condition of a single trophic macronucleus and a single sexual micronucleus, a condition perpetuated by subsequent asexual binary fission.

It will perhaps facilitate our conception of the fundamental similarity of the life processes of the life cycle of the Protozoa and the Metazoa if we turn our attention to the familiar life cycle of the malarial parasite in which Schaudinn distinguished a cycle separated into two phases based upon the host in which the parasite lives. It is in this sequence that this cycle is treated in the text-books and charts which base their account upon his investigations. All start the life cycle with the invasion of a red blood corpuscle by the sporozoite introduced by the mosquito into the blood of man.

Looking at this problem purely as a biological rather than an anthropomorphic phenomenon one is forced naturally to begin the life cycle not from the point of importance to man, but at the most significant phase of the organism itself, namely, the zygote. This, the so-called ookinete, is formed in the stomach of the mosquito by the fusion of the slender flagella-like macrogamete or spermatozoan with the larger spheroidal, passive, immobile macrogamete or egg. It is in reality a fertilized egg which creeps out of the stomach of the mosquito, encysts in the wall of this organ, and undergoes rapid cell divisions giving rise to a multicellular plasmodium-like sporoblast, having hundreds and perhaps thousands of cells in a common protoplasmic body at first spheroidal in form and retained within the encapsuling membrane. There is no histogenesis in this body. Then follows an asexual reproduction in which the body falls apart into its constituent cells, comparable in kind to the shaking apart of the blastomeres in the egg of *Amphioxus*. These separated blastomeres then differentiate in the unicellular sporozoite which may be transferred by the mosquito into the blood of man. Here they find a favorable field for their growth in or upon the red blood corpuscles and undergo a succession of mitoses giving rise to a small multicellular body which in turn undergoes asexual reproduction by simultaneous plasmotomy into its constituent cells, a process again similar to that of the breaking apart of the blastomeres of the egg.

This may be repeated again and again in the course of the cycle in the human host. There comes a time, however, in the life cycle in which certain of the merozoites instead of proceeding to the formation of new somatellas form instead gametocytes, and in the favoring environment of the mosquito's stomach proceed to the maturation of gametes. We have, then, in this protozoan, as in the case of the Metazoa and Metaphyta, the fundamental processes of fertilization, cleavage, asexual reproduction and gametogenesis with the gametocytes and gametes sexually differentiated. The parallelism is precise in every important respect except in the fact that histogenesis and organ differentiation do not appear even though the number of cells in the somatella on the wall of the mosquito's stomach may reach into the thousands.

It is also obvious that death is a normal part of this cycle as truly as it is in the case of a navel orange tree, the earthworm or man. It results, in the case of the navel orange tree, when any part of the original zygote disintegrates and is never fully accomplished until all its parts have disintegrated or have been transformed into gametes. The cycle of the individual extends from the zygote to the gametes. This individual is, of course, the Huxleyan individual and it dies when any of its parts which we may call functioning individuals die of disease or are destroyed by accident, or die of old age. But the Huxleyan individual does not entirely disappear until all of its parts reproduced asexually either perish singly or are transformed into gametes. Senescence and death in the navel orange tree are not unlike that in the malarial parasite. The original zygote which formed the navel orange is now dispersed in thousands and hundreds of thousands of navel orange trees throughout the orange orchards of the world. Some of these may produce new gametes, but in time they are destroyed by man and the environment, or grow old and perish, unless continued by asexual processes.

In the same way the malarial parasite dies with the formation of its gametes and is continued by asexual processes. In the case of *Paramœcium* the zygote undergoes cleavage, forms an eight-celled body which by asexual reproduction is reduced to the binucleate condition with the single trophic and a single sexual nucleus. This is continued indefinitely with the aid of endomixis, or at least the limits are not yet known to which lines of descent may progress by asexual reproduction.

There comes a time in the life of some of the asexually produced individuals in which the trophic nucleus or soma breaks down, its genetic control over the cytoplasm in which it has lived ceases. The sexual nucleus by the process of maturation takes over this body which in a dedifferentiated condition becomes that of the gamete, and ultimately that of the new zygote. We have here, then, in this and many other Protozoa, the rather exceptional phenomenon of the entire body of the parent controlled by the genetic complex of the macronucleus, growing old and its nucleus disintegrating and resorbed in the cytoplasm of the gametocyte and gamete. The gamete thus eats one of its parents. The only difference between this function and that of the hydroids or of a man lies in the fact that the amount of parental cytoplasm appropriated differs. *Paramœcium* takes it all, the human egg only a minute part. In both cases the ancestral genes which once controlled the parental cytoplasm are alike doomed to senescence and death, and a new régime is established in the new gamete and zygote.

We find also that there is a parallelism of deep significance between the relation of asexual reproduction in the Protozoa and in the Metazoa to the phenomenon of senescence and death. The tendency of asexual reproduction in all organisms is to prolong the chances of survival of the original zygotic complex in one or another functional individual. In every case senescence follows and death is the price of sexual reproduction. The length of time during which asexual reproduction may prolong the existence of functional individuals carrying original zygotic constituents is a matter to be determined only by experiment and observation. It is not essentially different in the Protozoa and the Metazoa.

When we turn to those primitive forms of life in which sexual reproduction has not as yet made itself apparent, we are faced by the fact that it would appear at first sight that death can not possibly be a phenomenon where sexual reproduction is unknown. This is true, however, only if the original genetic complex remains unchanged. Should there, however, occur in the life cycle of the Protozoa and other primitive organisms, including the bacteria, a periodic and recurrent reorganization of the nuclear structure involving permutations in the genes, we will be forced to admit that every such organization carries with it inevitably the seeds of death of the previous individual. The genetic complex which existed prior to the reorganization vanishes when that reorganization ensues and a new individual in every sense of the word comes into control of the organization.

I have brought forward this concept of the normality of senescence and death among the most primitive organisms as one which may be helpful in directing discussion and research into the nature, structure and periodical changes in the mechanism of heredity and the mechanism of organismal control of these simplest forms of life. It may perhaps be helpful and serve to facilitate progress if we emphasize the similarities of organisms and seek to find the common processes underlying them all rather than to emphasize their differences and thus obscure our vision of the more fundamental problems of life.

C. A. Kofoid

PRUNING THE ACADEMIC TREE[1]

There is little reason to offer excuse for discussing the method of presenting a scientific subject, if one but remembers that each science is rapidly expanding and as it does so the subject matter and pedagogical methods must be modified. We can not be content to teach as our forefathers taught even though they in their time were successful. Not so long ago there were naturalists who studied and taught all phases of science and the student obtained a certain advantage which is lost by our present system of special teachers. The intimate inter-relationships of the sciences are largely lost in the maze of special detail. The broad, inaccurate naturalists' teaching of earlier days had to give way to the closely analytic, specialized method of the last decade, but now the immense accumulation of data must be synthesized into the truly general, fundamental principles so as to free the students' time for further specialized study.

We all have been inclined, on the whole, to teach as though our students were going to be specialists in our particular subjects instead of realizing that this, in all likelihood, will be the one time in their course when they will come in contact with our subject. There is much that a specialist must know which but fogs the issue for one gaining general knowledge or training. We too often lose sight of the college ideal of education and attempt to turn out ambulating encyclopedias rather than individuals who are trained to organize and apply.

Each increase of knowledge has seemed to call for the addition of a requirement for graduation without greatly affecting the curricula already prescribed. The result packs the students' hours from entrance to graduation with one continuous procession of informational courses until, should the student by chance have a free hour in his program, he really feels guilty. Well might be inscribed over the gates of many of our colleges "Leave thought behind all ye who enter here" for small time is left for such intellectual processes.

We must cut the Gordian knot of required subjects for every hour of college life whenever possible in order that opportunity for individual selection may enter. We must recognize that in general elementary courses only the principles and not the details stick or are of ultimate value. Our work must be so planned that the student's life shall not be one galaxy of memorizing of facts accepted on authority but rather that he may have opportunity to coordinate and prove his acquisitions and so become different from the trained ape from which so many to-day are fearful of having descended.

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[1] Read before the North Dakota Academy of Science, May 5, 1922.

In all subjects there is something of recognized value to the well-trained mind but the time is past when we may know much about all things. We must present only the essentials of our subject to our students and let them judge whether they would go farther. Moreover, the increase in knowledge means that there are more fields for the student to investigate and as teachers we must eliminate many of the weeds in our intellectual gardens. Can this be done without making the student superficial? Our experience makes us feel certain that he will be better off under the proposed plan than under the cramming system.

It is becoming more and more evident that all living organisms, both plant and animal, are a unit in the principles which govern them. It is these fundamental ideas which are of importance to the great majority of students and it is these which they will carry away with them as the best heritage of an elementary biological course. Why then burden them with mastering a mass of detail, so soon to be forgotten?

In biology it has been the custom to start with the Amœba and end with man, hitting as many forms in between as time and the budget would permit. In one institution a student was heard to remark that specimens flowed past at such a rate that if he chanced to look around he lost a view of several. There are few teachers to-day who can make such a "type" course interesting and the student loses the great basic principle of life in viewing its numerous manifestations. It is far better to demonstrate the principles thoroughly with a few well chosen forms. We want the students to have at the end of their course a realization that metabolism, irritability, movement, reproduction and growth are the principles or characteristics of living matter. If this can be done and the student then brought to a realization of the organic variations which successfully carry on these functions, he has acquired about all of biology that will be useful to him. If his first experiences hold his attention then he may go on into the more advanced and specialized courses. We will in this method sacrifice only the time-honored, traditional and more or less useless detail. The fundamentals will stand out sharply in relief and in that form will not readily slip away.

Thus instead of two elementary courses, one in botany and one in zoology, a single course in the fundamental principles of biology may be developed with the cooperation of both departments. The student can not be a botanist or a zoologist from such a course, but neither will he be from an elementary course in either. He may, on the other hand, get a more comprehensive view of life and its essential applications to his than from a more specialized course in botany or zoology. Thus the general student is better served, but what shall we say of those who need special phases of either subject? They are better served in advanced courses where smaller numbers of students make for greater opportunity.

This plan has been put into operation at the North Dakota Agricultural College with what appear, from first returns, to be satisfactory results. Instead of six terms of elementary work in botany and zoology, two in the principles of biology are given. These are followed for special groups of students by special courses especially fitting their needs. Thus those who specialize in the agronomic phases of agriculture have three terms of advanced botany in place of one or possibly two heretofore. Likewise the animal husbandry students are especially served in the advanced courses in zoology. A unique feature of this plan is the complete cooperation of two departments in outlining and conducting the introductory course, not breaking the continuity of the subject matter into separate terms of botanical and zoological work. Thus unnecessary duplication is eliminated and every subject of discussion is strengthened by the presentation from both points of view.

The educational ideal would be to offer the student an opportunity of getting a rapid survey of all branches of learning that he might better be able to choose his field of interest. This not being entirely possible it is desirable that our general courses be pared to the core and we may rest assured that the subjects will gain rather than lose in their value to the students.

Students have justly complained that so many required subjects fill the curricula that they can not elect in their special field of interest during their last two years. At Barnard College the students have petitioned for such general survey courses in many subjects as that outlined here for biology.

Most of our academic trees carry much dead wood. Can not other collegiate subjects profitably eliminate much detail which now seems sacred in the elementary course and thus open the way for more intensive study in the later years of the students' curriculum?

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COOPERATION OF THE GOVERNMENT IN SCIENTIFIC WORK

IN view of the growing interest in cooperation as a means of advancing scientific work for the public benefit, the National Research Council in 1921 appointed a committee to study the nature and extent of cooperative scientific work carried on by the federal government and outside agencies as well as the principles which should guide in such work. This committee consisted of E. W. Allen, chief, office of experiment stations, United State Department of agriculture, chairman; Edwin F. Gay, president, New York Evening Post, Inc.; M. W. Glover, bureau of chemistry, United States department of agriculture; N. C. Grover, geological survey, United States Department of the Interior; Vernon Kellogg, permanent secretary, National Research Council; and E. B. Mathews, state geologist for Maryland and professor of geology, Johns Hopkins University.

The committee's report, which has just been made public by the council, shows a great diversity as to types of work, agencies cooperating, nature of cooperation, terms of agreement and extent of participation of the parties to it. The inquiry revealed 553 separate cooperative projects, involving more than 1,100 cooperative undertakings, since many of the projects involve the work of several cooperators. Of the 553 separate projects, 360, or nearly two thirds, fall under the head of research, the acquisition of new knowledge by the method of systematic scientific investigation; others deal with routine testing and technical service; gathering of statistics; enforcement of regulatory laws or measures; and the like.

The federal agencies engaged in the cooperative work included some 23 bureaus and independent establishments of the government, and the outside cooperating agencies included various branches of the state governments, municipalities, chambers of commerce, state and endowed universities, agricultural colleges and experiment stations, botanical gardens, and similar institutions, as well as associations and societies of various kinds and numerous industrial concerns and private individuals.

The forms of agreement or understanding entered into between the cooperating parties are very diverse. As a rule, however, they are quite definite, and in general, "convey the impression of having been developed in the spirit of cooperation and with a view to avoiding misunderstanding."

The combined cost to federal and outside cooperators of the definitely organized scientific work in which the government is concerned aggregated, as far as the available data show, more than $41,000,000 for the year under consideration. Of this, over $14,000,000 came from the federal government and nearly $27,000,000 from outside agencies. If the assistance other than money is included, it appears that the outside cooperating agencies are putting in fully two dollars for every one supplied by the government. As the report states, however, "the influence of the federal government in stimulating new movements for the application of science can rarely be measured by the amount of funds it has contributed. It has served to nationalize many types of effort important to the intelligent advancement of the country, and has greatly hastened the development of such measures."

Of the federal agencies concerned, the United States Department of Agriculture has the largest number and the widest range of cooperative undertakings. The report shows that the cooperative work covers the entire country and includes broadly "the study of the principles of agricultural science, the determination of agricultural resources and special adaptations, the discovery and introduction of improved or better-suited methods, the establishment of new crops, the improvement of plants and animals, the marketing of products, and the safeguarding of agriculture from a long list of enemies."

The cooperative enterprises to which the department of agriculture is a party, excluding cooperative extension and experiment station work, road building and management of forest reserves, involved in 1921 a total expenditure of nearly $15,000,000, of which the department supplied $5,844,307.

Leading purposes of the central government in fostering cooperation have been to provide for the more adequate scientific investigation of matters of general interest from a national or regional standpoint and to promote nationwide movements of various kinds. As pointed out in the report, "the scientific work which the government, the states and local institutions are called upon to perform is so vast and so varied that it is beyond the ability of a local or national agency to accomplish, working alone. Much of it is regional or national in importance or is for the benefit of science as a whole. To prevent its being fragmentary and disconnected, systematized effort is manifestly important."

The survey shows that cooperative scientific work is on a large scale and steadily increasing. In fact it is evident, as the report states, that such cooperation "has become a recognized principle of government." The number and range of the cooperative projects make it clear that "the states have no hesitation in joining hands with the federal government in carrying on research and development work of interest to them. . . . And that there is a manifest tendency on the part of the states to seek the aid of the federal government in measures of general or regional interest, and to link their efforts with those of the central agency, is shown by the fact that such proposals frequently originate locally."

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH IN AUSTRIA IN 1922[1]

In a short report to the government, which demonstrated the meagerness of the regular appropriations to the scientific research institutes, Professors Becke and Rademacher asked for larger appropriations, and enumerated the most important investigations conducted last year in this country. Apart from the publications dealing with the geographic and ethnographic researches in the Balkans in 1915-1918, when our armies occupied these countries, the results of which were made known in 1922, one of the most important papers was that by Dr. Schedler, who made geomagnetic surveys in thirty different places and found marked differences and changes from the values heretofore accepted.

The Vienna Radium Institute, a private concern, has done excellent work in the investigation of radioactive substances. It has been shown that the age of certain mineral deposits can be estimated according to the proportion of transformation or decay of the radioactive substances contained in them. While the uranium-pitchblende of Bohemia is about 200 million years old, in Norway there are minerals at least twice as old, and in Ceylon the layers of thorianite have been found to be at least 500 million years old.

A tremendous amount of work is still going on in the biologic institute (Vienna). Here the problems of transplantation have attracted the attention of a number of gifted investigators. The pupils of Przibram study especially the physiology of transplanted eyes, hearts and legs. Koppanyi has succeeded in transplanting eyes in rats, and these eyes seem to be functioning. At a recent meeting of the Vienna Ophthalmologic Society, his experiments were vehemently attacked by the oculists, but just as vehemently defended by the physiologists. Dr. Weiss transplanted entire limbs in amphibia, exchanging, for instance, arms and legs, and demonstrated that these transplanted limbs functioned normally after a few days. In a group of these animals, he could even transplant whole hearts into the peritoneal cavity. These transplanted hearts obtained an organic union with the new host, the animal thus having two hearts.

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[1] From the *Journal* of the American Medical Association.

In the chemical laboratories of the university, important researches on the catalytic effects of copper and of the methyl-groups of methylated benezene compounds are in progress. In the physical institute, studies on colors and their differentiation are conducted by Dr. Duschek-Frankfurt. A prehistoric cave, discovered in the Styrian Alps near Mixnitz, gave opportunity for the study of animals and plants of diluvial times, while the results of botanic researches in the Far East and in the African Sudan, begun by Austrians before the war, have been published recently.

PHYSICS IN INDUSTRY AT THE WEMBLEY LABORATORIES[1]

THE General Electric Company, Ltd., is now a very large organization, which employs some twenty thousand workers. It has engineering works at Birmingham, where it manufactures all kinds of electrical machines. At Stoke, near Coventry, telephones are manufactured. At the Osram lamp works at Hammersmith, lamps and valves of all kinds are made. At Erith, the company took over a few years ago the works of Messrs. Fraser and Chalmers, which manufacture steam turbines and mining plants. At Southampton, electric cables of all kinds are manufactured, and the company has glass works at Lemington-on-Tyne. Mainly on the initiative of Mr. Hugo Hirst, the managing director, it was decided some six years ago to establish a central laboratory to carry out the scientific and industrial researches which are essential for the progress of industry. Mr. Clifford Paterson, who was then the head of the electro-technical department of the National Physical Laboratory, was appointed superintendent, and he is now helped by a staff of physicists and engineers, many of whom have world-wide reputations.

The opening of the research laboratories on February 27 was a very interesting function. Lord Robert Cecil, speaking at the opening ceremony, said that the immediate task of the country is to repair the waste of the war. To do this the first and most essential requirement is to use every endeavor to increase the output of human energy and skill. This can only be done in two ways, namely, by reducing expenditure and by increasing the efficiency of production. Research, by making every man's skill go further, adds to the world's wealth. Science has no territorial boundaries. By promoting research the relations between this country and the world are improved. Sir J. J. Thomson, who also spoke, pointed out that it is absolutely necessary that a research laboratory should have a highly efficient staff. The capacity for the highest kind of research is rare. Training may increase the efficiency of a researcher, but it can not put insight and originality into him. It is also certain that no research laboratory can guarantee delivery. The output of such a laboratory is always highly irregular and spasmodic. Sir Joseph Thomson also dwelt on the importance of cultivating the thinking powers of the community to the utmost.

The research laboratories are situated near Wembley and have a total floor area of 80,000 square feet, but they have ample room for expansion. The building has a north-light roof and nearly all of it is only one story in height.

THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION

THE fifteenth session of the University of Michigan Biological Station will be held on the shores of Douglas Lake, Cheboygan County, Michigan, during the eight-week period from July 2 to August 24. This station offers unique advantages for the study of a fauna and flora marked by the inclusion of the northern boreal forms and many of the forms characteristic of the region further south, the area being in the transition zone between the northern-eastern coniferous forest area and the central deciduous forest. The summer climate of this region is ideal for outdoor work of all kinds.

The station is conducted as a camp, with log and frame buildings for laboratories and small frame houses and tents for living quarters. A mess, operated on the cooperative plan, furnishes table board for the members of the station. Located six miles from the nearest village and three miles from the nearest farmhouse, the station furnishes a fine experiment in community life. This isolation makes for a minimum of distraction and for concentration of interest upon biological work.

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[1] From an article in *Nature*.

The class period lasts through the working day, thus permitting all-day field trips. Certain classes make two or three day excursions to the sand dunes along the shore of Lake Michigan. The curriculum for this session has been enriched by the addition of new courses and the expansion of some of the old. Courses will be given in ichthyology, limnology, entomology, ornithology (two courses), herpetology and mammalogy, cryptogamic botany, taxonomy of the bryophytes, systematic botany (two courses), ecology and plant anatomy. Students undertaking research under direction will find a wide variety of fields from which to select subjects for investigation. The more than one hundred and twenty-five published papers bearing on the biota of the region attest the interest of former members of the station and the encouragement given research by those in charge.

The teaching staff will include Professor P. S. Welch and Dr. F. N. Blanchard, of the University of Michigan; Professor H. B. Hungerford, of the University of Kansas, and Mr. Francis Harper, of Cornell University, in zoology; Professor J. H. Ehlers, of the University of Michigan; Professor F. C. Gates, of the Kansas State Agricultural College; Professor G. E. Nichols, of Yale University, and Dr. H. A. Gleason, of the New York Botanical Gardens, in botany. Mrs. Margaret T. Gates will serve as dean of women, and Dr. Warren E. Forsythe, of the University Health Service, will be the physician to the biological station. All inquiries should be addressed to the undersigned.

George R. La Rue,
Director

Ann Arbor, Michigan

RUSSIAN EXILED INTELLECTUALS IN BERLIN

Those who responded to an appeal made by me through Science some time ago for small sums to make up a total of one thousand dollars to be used for the special relief of approximately one hundred Russian university professors and other intellectuals exiled from Russia by the soviet government, and now trying to keep alive in Berlin, where local charity is feeding and lodging them, but is unable to do more, will be interested in news of what is being done with the money put into my hands.

The total amounted to a little more than twelve hundred dollars. This was sent to Berlin to be carefully distributed by a special small Russian committee, overseen by Captain Gardner Richardson, of the American Relief Administration, and Mr. Paul B. Anderson, of the Y. M. C. A. The committee is composed of Professors N. A. Berdiaeff, Bogilepoff and Iassinsky and Mme. E. L. Kousskoff. The first action of the committee was to express its gratitude to the individual donors of the money and to the editor of Science, and to ask me to make this gratitude known to these persons. This is done herewith.

The second action was to begin at once a careful distribution of the money. I have a full list of this distribution as so far made. It is a pathetic document. I can use space to note but two or three items:

To E. L. Soubasheff, former rector of the Technological University of Tomsk, $15.

To A. L. Baikoff, professor in the University of Moscow, with family, $30.

To I. A. Iljin, professor of Moscow University, with family, $30.

To V. D. Golovatcheff and I. L. Tchesliar, members of student organizations in Moscow, sent out with professors, each $10.

And so on. I hope that each donor will realize how much his money is doing. Ten dollars make the difference between suicide and keeping alive for some of these people.

Vernon Kellogg

National Research Council

SCIENTIFIC NOTES AND NEWS

Sir Joseph Thomson gave an address at Yale University on April 4 in connection with the dedication of the Sterling Chemistry Laboratory and the meeting of the American Chemical Society. His subject was "The unity of physics and chemistry." Next week he delivers a course of lectures at the Franklin Institute, Philadelphia.

Professor Albert Einstein, of the University of Berlin, delivered three lectures in French at Madrid during the first week in March. The King presided at a sitting of the Academy of Science at which Professor Einstein was elected a member.

The Willard Gibbs Medal of the Chicago section of the American Chemical Society has been awarded to Professor Julius Stieglitz, of the University of Chicago, for his researches in organic chemistry. The medal will be presented in May.

The University of Dublin on March 12 conferred the honorary degree of M.D. upon Dr. William James Mayo, of Rochester, Minnesota.

Dr. Stockis, professor in the University of Liége, has been elected president of the Belgian Federation of Scientific Societies.

Professor André Mayer has been elected president of the French Society of Biological Chemistry.

Leonard Sumner was elected president of the British Institute of Metals at the annual meeting on March 7.

The Joseph A. Holmes Safety Association of Washington, D. C., has awarded the gold medal of the society to Dr. Andrew W. Springs, Dewmaine, for his heroic work in the Royalton explosion of October, 1914.

The Adams prize for an essay on "The theory of the tides" has been awarded by the University of Cambridge to Mr. J. Proudman, Trinity College, director of the Liverpool University Tidal Institute.

Professor George E. Beggs, of the civil engineering department of Princeton University, has been awarded the Wason Medal for 1922 by the American Concrete Institute for the most meritorious paper before the institute. The subject of this paper, which was delivered a year ago, was "The mechanical solution of indeterminate structures."

At a meeting of the Academy of Natural Sciences of Philadelphia held on March 20, the following were elected correspondents: Charles W. Andrews, Ignacio Bolivar y Urrutia, Marcellin Boule, Friedrick Czapek, Herman L. Fairchild, Stephen A. Forbes, Gia Battista Grassi, Louis R. Jones, Vernon L. Kellogg, Charles A. Kofoid, James Playfair McMurrich, George P. Merrill, James G. Needham, Charles C. Nutting, W. J. V. Osterhout, Reginald C. Punnett.

As a token of admiration and gratitude to Dr. James Perrin Smith, professor of paleontology at Stanford University, about one hundred of his students and former students, many of them now eminent in geology and engineering, recently presented him with $10,000 at a campfire supper in the court of the geology buildings on the Stanford campus. Among those who spoke were R. P. McLaughlin, of San Francisco, former head of the petroleum department of the state and now a consulting geologist; E. B. Kimball, a mining engineer associated with W. P. Hammond in San Francisco; R. S. Holway, professor of physical geography in the University of California; A. M. Strong, consulting engineer in Los Angeles; Ralph Arnold, consulting geologist and petroleum expert in Los Angeles; T. J. Hoover, head of the department of mining at Stanford University, and R. B. Moran, geologist and engineer of Los Angeles.

Dr. Elihu Thomson, of the General Electric Company, Lynn Massachusetts, was tendered a dinner in the Boston City Club on March 29 by more than seventy-five friends and associates in the General Electric Company, and from Harvard University and the Massachusetts Institute of Technology, on the occasion of his seventieth birthday anniversary. He was presented with a silver loving cup, the presentation being made by Walter C. Fish, formerly manager of the Lynn works, who served as toastmaster. There were addresses by Professor A. E. Kennelly, of Harvard University; Professor Dugald C. Jackson, of the Massachusetts Institute of Technology; Professor Comfort Avery Adams, of Harvard University; George E. Emmons, of Schenectady, vice-president of the General Electric Company; J. R. Lovejoy, of New York City, also a vice-president of the company; Herman Lemp, of Erie, Pennsylvania, and F. P. Cox, of Lynn, Massachusetts.

Dr. Walter Rosenhain, chief of the metallurgical department of the National Physical Laboratory, Teddington, England, who has been lecturing in the United States, was on March 31 tendered a banquet at the Cosmos Club under the auspices of the Washington Academy of Sciences. Following the dinner, he spoke on "The structure and constitution of alloys."

THE report of the findings of the board of visitors to the Bureau of Standards has been issued. The board of visitors is composed of John R. Freeman, former president of the American Society of Civil Engineers; Ambrose Swazey, former president of the American Society of Mechanical Engineers; F. W. McNair, president of the Michigan School of Mines; S. W. Stratton, president of the Massachusetts Institute of Technology, and Wilder D. Bancroft, professor of chemistry at Cornell University.

WILLIAM R. HART, since 1907 head of the department of agricultural education at the Massachusetts Agricultural College, retired under the law of the state of Massachusetts on March 31, on his seventieth birthday.

DR. F. C. WEBER, since 1907 chemist in charge of the animal physiological laboratory of the Bureau of Chemistry, has accepted a position with the Fleischmann Laboratories, New York.

PROFESSOR J. B. HILL has resigned his position as professor of electrical engineering in the Iowa State University to enter the public utility field at Lincoln, Nebraska. He will be general manager and consulting engineer of the Lincoln Gas and Electric Company.

DR. WILLIAM N. BERG has resigned his position as pathological chemist in the pathological division, Bureau of Animal Industry. He is now engaged in the manufacture of biological products at the Berg Biological Laboratory, Brooklyn, New York.

DR. W. A. MURRILL left on March 3 for a collecting expedition in Florida. His trip will extend down the west coast from Crystal River to the Keys and back on the east coast as far as Daytona. Chief attention will be given to the collection of fungi.

THE twenty-eighth annual meeting of the Michigan Academy of Sciences, Arts and Letters opened in Ann Arbor on March 28. Professor William B. Scott addressed the academy on March 29 on "Evidences of evolution."

DR. OTTO MEYERHOF, professor of physiology at the University of Kiel, will deliver the eleventh Harvey Society lecture at the New York Academy of Medicine on Saturday evening, April 14. His subject will be "Autooxydation processes in the cell."

DR. LOUIS A. BAUER, director of the Department of Terrestrial Magnetism, gave on March 31 an illustrated talk at the General Electric Company, Schenectady, N. Y., on "The present status of our knowledge regarding the constitution and causes of the earth's magnetic field." He also gave a talk on "The earth's magnetism" at the General Electric Company, West Lynn, Massachusetts, on March 30.

PROFESSOR RICHARD GOLDSCHMIDT, of the Kaiser Wilhelm Institut für Biologie, Berlin, recently invited to deliver a series of lectures in England on his work concerning the sex problem, has lectured before the Genetical Society and at the Universities of Oxford, Cambridge and Liverpool.

PROFESSOR JOSEPH S. AMES, of the Johns Hopkins University, will give the Wilbur Wright memorial lecture of the Royal Aeronautical Society in London on May 31.

PROFESSOR H. A. LORENTZ, of Haarlem University, will on May 15 deliver the Rede lecture at the University of Cambridge on "Maxwell's electromagnetic theory."

SIR JAMES DEWAR, the eminent British chemist, died on March 27 in his eighty-first year.

DR. NORMAN DALTON, formerly senior physician to King's College Hospital, professor of pathological anatomy in King's College, and lecturer on medicine at the medical school, died on March 9, aged sixty-five years.

PROFESSOR IGNAZ VOGEL, director of the bacteriological department of the Agricultural Institute of the University of Leipzig, has died at the age of fifty-two years.

PROFESSOR PAUL JACOBSON, general secretary of the German Chemical Society, died in Berlin on January 26.

UNIVERSITY AND EDUCATIONAL NOTES

Rensselaer Polytechnic Institute receives $40,000, Princeton University $50,000, and Lafayette College $50,000 by the will of Calvin Pardee.

The building of metallurgy at the Michigan College of Mines, Houghton, Michigan, was destroyed by fire on March 15, with loss estimated between $250,000 and $275,000. Valuable records were lost, including those of the United States Bureau of Mines, occupying offices in the building.

Courses constituting the first two years of the four-year course in medicine at Rush Medical College are given at the University of Chicago and include work in zoology, anatomy, physiology, physiological chemistry and pharmacology, pathology, hygiene and bacteriology. For the summer quarter the regular faculty in these courses will be supplemented by men from other institutions, including Wade Wright Oliver, professor of bacteriology, Long Island College Hospital; William Barnard Sharp, professor of preventive medicine, University of Texas Medical School; William Alfred Starin, professor of bacteriology, Ohio State University, and Andrew Conway Ivy, assistant professor of physiology, Loyola University.

Eugene J. Rights, a graduate of Lehigh University who has been engaged in bridge construction, has been appointed professor of civil engineering at the University of Porto Rico.

Dr. L. Plasencia has been appointed professor of biological chemistry in the University of Havana.

Mr. M. B. R. Swann has been elected to a fellowship at Gonville and Caius College, Cambridge, and appointed a lecturer in pathology.

DISCUSSION AND CORRESPONDENCE

WEATHERWAX ON MAIZE ENDOSPERM[1]

Dr. Weatherwax has recently contributed a very interesting paper to *Genetics* entitled "A rare carbohydrate in waxy maize." It is written with that inimitable blending of the didactic and the dogmatic which approaches true perfection in all of the author's work.

Two ingenious ideas led to this paper. Presumably there would be no claim that these ideas are absolutely original; but at least they have not been utilized before to the full extent of their possibilities. The investigation consists of observing the color reaction when iodine dissolved in aqueous potassium iodide is applied to the endosperm of a variety of maize. In itself this is not new. It has been done frequently by various botanists, and even by geneticists. The novel idea, the idea which might be termed ingenious without misrepresentation, is to make a complete and well-rounded investigation out of this one experiment. The second adroit idea is to omit all the vulgar details of this test in order that there may be no hindrance, obstruction or inhibition which might prevent the fullest freedom in drawing the most general conclusions. This again has its prototype. Sir Isaac Newton is said to have made a single experiment with falling bodies, utilizing the apple as material; yet the plan, the scope, and the mode of carrying on his observation are unmentioned in the two great works to which it gave rise. Thus it will be seen that the author deserves high credit for eliminating all that is extraneous and leaving his work characterized by utmost simplicity.

But it is in the comments, conclusions and generalizations regarding genetics that Dr. Weatherwax's originality is most striking; though it must be confessed they have a generic resemblance to those of other morphologists who have invaded the field. His first conclusion is that since waxy maize gives a red color with the iodine solution, its endosperm is composed wholly of erythro-dextrin, a rare carbohydrate having the unique property of producing this color reaction. Generously, though perhaps unnecessarily, he cites as corroborating authority for these facts a paper by Meyer written in 1886. Doubtless because chemical literature is notoriously erroneous, he has been able to dispense with the relatively large literature on the subject, much of which has been brought together by Abderhalden in the *Biochemisches Handlexicon.* It might be of a little historical interest, however, to note that Haas and Hill (*Chem. Plant Prod.*, p. 107), after commenting on the ill-defined mixture of substances known collectively as dextrins, quote Ost as disputing the existence of erythro-dextrin as a chemical entity because he has obtained the red reaction with iodine on an artificial mixture of achroo-dextrin and starch.

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[1] Weatherwax, Paul. A rare carbohydrate in waxy maize. *Genetics*, 7, 568-572, 1923.

Our author is at his best, however, in scourging the careless, inefficient genetic work of the past. He says in one place: "Geneticists of the past quarter of a century have found in hybrids between sweet and starchy varieties of maize, material readily utilizable for illustrating Mendelian ratios. But in the majority of the experiments reported, the 3 to 1 ratio expected in the conventional F_2 generation (of endosperms) has been complicated by the occurrence of grains intermediate between sweet and starchy." In determining to use the word "majority," the hundreds of crosses reported by Emerson, East, Merle Coulter and others, where only 1 or 2 per cent. of the matings were thus complicated, were omitted. The reasons for the omission will probably be given in a later paper.

Geneticists will also await expectantly an explanation of the statement that "the usual recourse has been the citation of the possibility of reclassification, based upon the degree of expression of the characters concerned, or an interpretation based upon various observed or assumed conditions." Until our attention was drawn to the case, the method used by geneticists of classifying doubtful individuals by the common practice of growing them and finding out how they breed had seemed just and proper.

Again, Dr. Weatherwax shows his clairvoyance in regard to genetic work by pointing out how much fruitless investigation of the maize endosperm could have been avoided by paying attention to its chemical and physical nature. If this had been done, he says, the divergent views of Dr. Harper on the one hand, and geneticists on the other, would be brought closer together, and Dr. Jones's investigation of the heredity of "pseudo-starchy" endosperm might have had more conclusive results. And with telling effect, he deals a final blow with an apt and striking metaphor. He says: "The visual method of discriminating between endosperm textures by observing the outside of the grain is as crude as a color-blind man's attempt to describe the rainbow."

Numerous other genetic hypotheses, which the author did not see fit to mention, fall before this type of criticism. Dr. Morgan has been crossing and recrossing *Drosophila melanogaster* for the past fifteen years, and has built up a seemingly consistent, orderly and logical scheme of inheritance upon the results. But many persons have felt that this consistency, this orderliness, this apparent logic was perhaps a mere phantasy or mirage which would disappear when a particular dispelling agent was discovered. Is it not probable that Dr. Morgan's ignorance of the chemical constitution of the characters with which he is dealing has led him into a maze from which he can never extricate himself? Furthermore, it is unquestionably true that in Dr. Jones's researches on the heredity of "pseudo-starchy" endosperm, he was unable to state the exact chemical constitution of the characters with which he dealt. There seems no escape from the conclusion that the deficiency vitiates his work.

Geneticists were not interested in whether there was a difference of opinion between Jones and Harper. They were interested in the facts. And these facts seemed to prove that "pseudo-starchy" had a different heredity from "true" starchy and from "sweet" endosperm. They accepted his work as an advance in knowledge on this account, even though a simple interpretation of the heredity mechanism was impossible. How crude and unsophisticated such a view now appears!

The reviewer does not wish to put an interpretation on Dr. Weatherwax's statements which he himself did not intend, but there appears to be a mute accusation between the lines of his metaphor concerning the color-blind man. Do geneticists endeavor to camouflage their deficiencies to the public by appearing to be doing the things which Dr. Weatherwax says they do not do? We have been in several genetic laboratories where maize endosperm was being investigated. The workers were cutting sections said to be for microscopical study. They were treating their material with various chemicals supposedly to try to gain an insight into the chemical composition of the material. Perhaps their silence on this matter, as contrasted with their relative multiloquence on the pedigree culture data, is indicative of a capacity to judge the comparative importance of the facts, rather than a crafty masking of inefficiency.

E. M. East

NEW OCCURRENCE OF THE BELT TERRANE IN MONTANA

No occurrence of the Belt Terrane in central Montana has been reported east of the Little Belt Mountains which were mapped in 1892-97 by Weed and Pirsson in Folio 56 of the United States Geological Survey.

Recently the writer has discovered over 100 feet of the top of the Belt Terrane in the Big Snowy Mountains. These mountains are about thirty miles long and are located east of the Little Belts, from which they are separated by a pass several miles broad called Judith Gap. The Big Snowies are the result of an anticlinal fold and contain no igneous rock, thus differing from all the rest of the outlying ranges in Montana. The summit of the uplift was reached at Half Moon Pass in the eastern part of the range, and the exposure of the Belt Terrane is on the south side of this pass in the canyon of Swimming Woman Creek.

The exposure of the Belt consists of dark gray, reddish and greenish shale or fissile slate. The rock is hard and highly fractured. Veinlets of iron stained quartz and calcite containing small amounts of gold and copper fill some of the fractures and joints in the strata. The Belt Terrane is exposed over an area of possibly two or three hundred acres. The Belt is overlain by more than 1,000 feet of Cambrian strata at the base of which is a quartzitic basal conglomerate. The walls of Swimming Woman Canyon are composed of the Cambrian and the hard Devonian and Mississippian limestones. There is an angular unconformity of a few degrees between the basal Cambrian quartzite and the Belt Terrane, but the Belt shows no evidence of extensive erosion. No fossils were seen in the Belt rocks.

The Big Snowy Mountains have never been mapped geologically, and the discovery of Belt strata in them extends the known area containing Algonkian strata forty miles farther east than hitherto reported.

O. W. Freeman

Stockton, Calif.

THE SCALES OF THE FOSSIL FISH EOBRYCON

Owing to the remarkable distribution of the Characinid fishes in the neotropical and ethiopian regions and consequent questions as to their origin and migrations, any scrap of information concerning fossil forms is of value. In 1898 Dr. A. S. Woodward described and figured *Tetragonopterus avus* from the Tertiary of São Paulo, Brazil. He considered that it might belong to the subgenus *Hemibrycon*, which is now considered a quite distinct genus. However, in 1907 Jordan made it the type of a new genus *Eobrycon*. In 1920 Dr. Eigenmann sent me a specimen, lacking the head, for examination. I found that the scales were exactly those of *Salminus*, and I think the fish must be placed in that vicinity. In his very excellent work on the fishes of western South America, just published by the Carnegie Museum, Dr. Eigenmann, in accordance with most ichthyologists, neglects to use or refer to the finer characters of the scales. I venture to predict that the time will come when scale-characters will be considered more valuable for generic diagnosis among the Characidæ or Characinidæ than the presence of an adipose fin or the completeness of the lateral line. More valuable because more constant and characteristic of natural divisions.

T. D. A. Cockerell

University of Colorado
January 30, 1923

SCIENTIFIC BOOKS

LOFTFIELD ON STOMATA[1]

Not since the appearance of Lloyd's "Physiology of Stomata" in 1908 has there appeared in America a book which has taken up the problems involved in the behavior of stomata on the broad and comprehensive scale, and as possibly related to agricultural and industrial practices, as does this publication. For many years there has been a growing demand for more accurate information regarding the inter-relations of stomatal activity and environmental conditions. This situation became particularly critical a few years ago in connection with studies of smelter smoke injury in various parts of the continent and that stimulus finally culminated in the investigations which Dr. Loftfield has reported in this book. Many field and garden crop plants were included in the investigations.

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[1] "The Behavior of Stomata." By J. V. G. Loftfield. Publication No. 314, Carnegie Institution of Washington. Pp. 104; 54 figures in text, 16 plates with 27 figures. Washington, D. C., 1921.

The author, using the methods of Lloyd with some modifications, in the first portion of the work brings out some rather striking results. The daily march of stomatal movement varies considerably from day to day, in fact is seldom identical on two successive days. He states that such variations are due to changes in water-content and weather. In nearly all cases stomatal opening is correlated with light under favorable conditions, but in some cases light seems to play little or no part as a control. An outstanding feature of this portion of the work is the report that some plants, such as the potato, tend to maintain open stomata at night under optimum conditions of water-content, and that the behavior of stomata in upper and lower surfaces is usually quite different. In general the stomatal movements of each plant follow a regular course under optimum conditions, a course which is modified as conditions depart from the more favorable.

Part II brings us face to face with the complex inter-relations of environmental and internal factors as related to stomatal behavior. The author seems particularly emphatic in his statements that no ordinary atmometer or evaporimeter yet devised can be used to measure at all accurately the effect upon the plant of all of the factors concerned in evaporation. This may come as a shock to some of the enthusiasts in the field of "atmometry." Wind was found to cause increases of transpiration unlike the increases of evaporation measured by atmometers.

Plants tend to show much less response to wind than do atmometers, but with a sudden high wind they often reveal greater response. All attempts to correlate evaporation from atmometers and from free-water evaporimeters with transpiration failed, and led the author to state that "Until an atmometer is devised which responds in the same manner and degree to each of the factors concerned, the ratio of transpiration to evaporation is meaningless." His work tends to support the contention that there is no warrant for the view that lack of agreement between stomatal movement and "relative transpiration" based upon evaporation from the porous-cup atmometer indicates that stomata are non-regulatory.

A reduction of light intensity to less than half (as measured by the "solio" photometer) is commonly necessary to produce any effect upon the stomata of plants growing in the open. When stomata are closing they are affected by decrease in light more rapidly than when they are opening. Stomata may open at night as a result of moonlight or a strong artificial light of much less intensity than one per cent. of the solar maximum. They open more readily toward morning than before midnight. This part of the work, on the whole, leaves one with a sense of incompleteness and confusion, although it serves to reopen many long debated problems, and to contribute many additional data to indicate that it will be many years yet before we are provided with an adequate and comprehensive body of dependable facts and principles relative to the effects of habitat factors and plant development upon stomatal behavior.

The concluding part of the book records some interesting studies of the effect of stomatal movement upon transpiration, a favorite topic for ecological investigations. The author presents data which lead him to conclude that stomata *do regulate the water-loss from plants,* and so to question seriously the value of the work of Lloyd. He demonstrates the reasons for this notable lack of agreement and points out that Lloyd's evidence that stomata are non-regulatory is vitiated by his use of potometers to measure the water-loss of field plants. However, a careful perusal of the present text leaves the reaction that Loftfield's "evidence" upon the basis of which he summarily disposes of the potometer method is rather meager, especially as compared to that presented by Lloyd.

The author's opinion as to the regulatory rôle of stomata is nicely put in the concluding statement: "Although the factors concerned in evaporation have great influence upon evaporation, this influence is definitely controlled by the stomata. When the stomata are wide open or nearly wide open, transpiration is the result of the action of the factors of evaporation alone, since the stomata in nowise interfere with the action. As the stomata close, the influence of the factors is lessened, but until closure has reduced the apertures to fifty per cent. or less, stomatal regulation is still largely overshadowed by the control exerted by them. When closure is almost complete, the regulation of water-loss by the stomata is very close and the effect of the factors overshadowed by the effect of even very small changes of the opening." This is, of course, quite different from the conception of "regulation" of some physiologists when they have attempted to compare the stomata-transpiration complex with the mechanism which rather effectively controls or "regulates" the speed of an engine under a variation of load.

The plates showing the features of the stomata in various plants under various conditions should receive special mention. The micro-photographs are arranged radially in such a manner as to show the condition of the stomata in upper and lower epidermis, especially the degree of opening, at each hour of a twenty-four hour day, together with curves for sunlight, temperature and humidity plotted toward the center of the circular figure. This commendable method enables one to compare readily the condition of the stomata in upper or lower epidermis at different hours of day or night and as related to the light, temperature and humidity values.

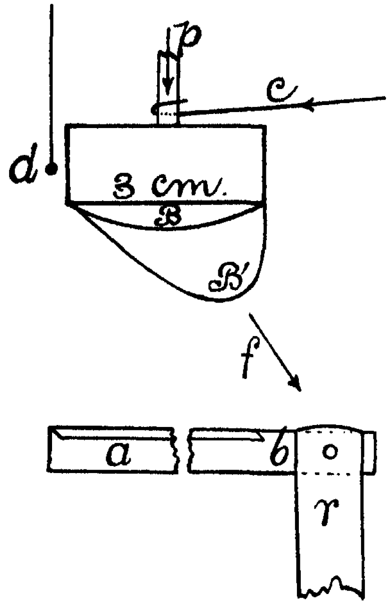
Loftfield's book is very stimulating, on the whole. It must be in the hands of every investigator working on problems in which stomatal behavior is involved.

Raymond J. Pool

SPECIAL ARTICLES

SPARKLESS SPARKS[1]

1. The endeavor to take away all the internal pressure (measured by the U-tube interferometer as in the preceding paper) from the soap bubble by charging it electrostatically, does not usually succeed unless the bubble is well anchored; otherwise the lower end is apt to break apart and fly off along the lines of force. A wide blower (say 3 cm. in diameter) as in the figure, with but a small segment of bubble *B* projecting, is satisfactory. The initial pressures are thus reducible to .04 mm. of Hg, so that with flattish bubbles I have actually obtained negative pressures within, on charging.



The charged bubble usually takes an oblique oval figure, *B'*, being drawn out along the incidental lines of force *f*. This expansion, on very slowly increasing the potential, reaches a maximum, after which the bubble suddenly, in fact spasmodically, jerks back from *B'* to *B*, remaining intact. With the same bubble a succession of 10-40 spasms may be easily obtained, at the end of which the bubble bursts. A pitch ball, *p*, near the metallic holder shows a definite but only very slight diminution of obliquity at each spasm. An adapted aluminum electroscope (right angled strip of aluminum, say 8 inches long, .03 mm. thick, flexible at *b*, appressed against a hacksaw blade and clutched by the hard rubber stem *r*) placed below *B'*, indicates a marked increment of potential, even at the least spasm of the bubble, from the beginning up to the maximum. With each such case, therefore, there is partial discharge, an outrush or ions, or an intermittent current. A few of the lines of force break loose and slide off.

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[1] Advance note, from a Report to the Carnegie Institution of Washington, D. C.

2. As I understand the phenomenon, it is near the tip, *B′*, that the surface tensions acting with a component inward are first balanced by the electric pressure $2\pi\sigma^2$ outward. The application of the latter is strictly on the outer surface. Hence the surface layer of molecules is successively slid toward the point and then stripped off, until after ten or more repetitions, the remaining tissue is so thin that it breaks. This ionized molecular exfoliation, which takes place entirely without light effects even in the dark, may be referred to as in the caption.

In the beginning, when the bubble is thick at the bottom, holding a drop, etc., the first faint sparks imply an internal pressure reduction of less than 25 dynes/cm². At the end, when the bubble is possibly thinnest at the bottom, the pressure reduction is usually about 55 dynes/cm², and it is here that the surface tension proper competes with the electric pressure. If the pressure to produce a spark be estimated at 68 dynes per cm², the lines would seem to break off, to this extent, more easily from a liquid than from a solid surface; but in view of the varied curvature of the bubble, it is difficult to ascertain the distribution of the contending forces. The difference of capillary and electrical pressure only must be constant and it is rather remarkable that the two data given are so near together.

CARL BARUS

BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE TREASURER FOR 1922

Accepted by the Council, A. A. A. S., at Cambridge, Massachusetts, December 26, 1922

TO THE COUNCIL OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE:

Gentlemen:

IN conformity with article 15 of the constitution and by direction of the council, the treasurer has the honor to submit the following report for the period December 20, 1921, to September 30, 1922. *This period covers the time necessary to comply with the new arrangement for the fiscal year of the association.* Henceforth the fiscal year of the treasurer will begin on October 1 and end on September 30.

The total of cash receipts during the period is $4,803.14. Disbursements made in accordance with directions of the council amounted to $4,720.10.

The total amount of funds of the association, consisting of cash, cost value of securities purchased, and appraised value of securities received from the Colburn estate is $121,414.77.

A detailed statement is appended.

(Signed) ROBERT S. WOODWARD,
Treasurer

Washington, D. C.
September 30, 1922.

TREASURER'S CASH STATEMENT

December 20, 1921 to September 30, 1922

Receipts

December 20, 1921, balance from last report		$ 5,585.90
Interest from securities	$ 4,772.13	
Interest from bank balance	31.01	
		4,803.14
		$10,389.04

Disbursements

Grants:		
B. E. Livingston, permanent secretary (for Dr. Greenman)	$ 500.00	
A. W. Smith	150.00	
L. R. Ingersoll	150.00	
F. C. Blake	150.00	
A. W. Rowe	250.00	
Harold Hibbert	200.00	
William C. Rose	100.00	
W. Tyler Olcott, Secretary	200.00	
Caroline E. Furness	100.00	
Herman J. Muller	250.00	
S. O. Mast	200.00	
Ralph E. Benedict	125.00	
Fred T. Rogers	200.00	
Frank P. Knowlton	200.00	
Frank H. Hartman	150.00	
Sebastian Albrecht	100.00	
Otis F. Curtis, Treasurer	250.00	
John T. Buchholz	125.00	
August F. Foerste	150.00	
F. Canu	250.00	
Raymond Dodge	400.00	
Franklin O. Smith	300.00	
		$ 4,500.00
Two life memberships from Jane M. Smith Fund		200.00
Rental of safe deposit box		20.00
Foreign exchange		.10
		$ 4,720.10
Cash in banks:		
Fifth Avenue Bank	$ 4,397.60	
U. S. Trust Company	1,271.34	
		5,668.94
		$10,389.04

TREASURER'S BALANCE SHEET

September 30, 1922

Assets

Investments:	
Securities (Exhibit A)	$121,414.77
Current Assets:	
Cash in bank	5,668.94
	$127,083.71

Liabilities

Funds and Accumulations:		
Life, sustaining members and patrons*	$ 29,500.00	
Jane M. Smith	5,000.00	
W. Hudson Stephens	4,381.21	
Richard T. Colburn	77,755.74	
Accumulated income invested in securities	4,777.82	
		$121,414.77
Unappropriated interest		5,668.94
		$127,083.71

SCHEDULE OF SECURITIES

(Exhibit A)

Par Value		*Purchase Value*
$ 10,000	Chicago and Northwestern Railway Co. General Mortgage 4 per cent. bonds, due 1987	$ 9,425.00
$ 10,000	Atchison, Topeka and Santa Fe Railway Co. General Mortgage 4 per cent. bonds, due 1995	9,287.50
$ 10,000	Great Northern Railway Co. First and refunding mortgage 4.25 per cent. bonds, due 1961	10,050.00
$ 10,000	Pennsylvania Railroad Co. Consolidated mortgage 4.5 per cent. bonds, due 1960	10,487.50
$ 10,000	Chicago, Burlington and Quincy Railroad Co. General mortgages 4 per cent. bonds, due 1958	9,350.00
$ 10,000	Union Pacific Railroad Co. first lien and refunding mortgage 4 per cent. bonds, due 2008	9,012.50
$ 10,000	Northern Pacific Railway Co. prior lien railway and land grant 4 per cent. bonds, due 1997	9,187.50
$ 10,000	New York Central and Hudson River Roalroad Co. 3.5 per cent. bonds, due 1997	8,237.50
100	U. S. First Liberty Loan Bonds	91.25
10,500	U S. Second Liberty Loan Bonds	10,172.36
2,000	U. S. Third Liberty Loan Bonds	2,000.00
2,000	U. S. Fourth Liberty Loan Bonds	2,000.00
6,500	U. S. Victory Liberty Loan Bonds	6,373.66
		$ 95,674.77
	Bonds from Colburn Estate	
20,000	Acker, Merrall and Condit Co. debenture 6 per cent. bonds	13,600.00
7,000	Buffalo City Gas Co. first mortgage 5 per cent. bonds	1,540.00
8,000	Park and Tilford Co. sinking fund debenture 6 per cent. bonds	6,400.00
42,000	Pittsburgh, Shawmut and Northern Railroad first mortgage 4 per cent. bonds, due February 1, 1952	4,200.00
		$ 25,740.00
$173,500		$121,414.77

All of the above named securities, except those from the Colburn estate, are registered in the name of the association.

AUDITOR'S REPORT

I certify that I have audited the accounts of the treasurer of the American Association for the Advancement of Science for the period December 20, 1921 to September 30, 1922; that the securities representing the investments of the association have been exhibited and verified; with the exception of the P. S. and N. R. R. bonds which were represented by a receipt from the Columbia Trust Company of New York, and a $100 United States bond represented by a receipt from the United States Treasury Department, for title transfer, and that the income therefrom has been duly accounted for.

The financial statements accompanying the treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof.

(Signed) ROBERT B. SOSMAN,
Auditor

Washington, D. C.
December 12, 1922.

TREASURER'S REPORT ON AGGREGATE RECEIPTS AND DISBURSEMENTS SINCE AUGUST, 1894

To the Council of the
American Association for the
Advancement of Science.

Gentlemen:

Supplementing my report of September 30, 1922, I beg to state that interest collections since September 30, 1922 (date of report), amount to $1,009.38. This amount added to collections reported in statement of September 30 gives a total collection of $5,812.52 during the year.

An aggregate statement of receipts and disbursements from August 21, 1894 to September 30, 1922 is appended. This statement shows collections from all sources amounting to $161,940.76 and disbursements amounting to $162,123.61, of which $121,414.77 represents cost of invested funds.

Respectfully submitted,

(Signed) ROBERT S. WOODWARD,
Treasurer

Washington, D. C.
December 20, 1922

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*The records show this item of $29,500 as made up of 438 life memberships of $50 each, 16 life memberships of $100 each, and 6 sustaining memberships of $1,000 each.—B. E. L.

Receipts

August 21, 1894 to September 30, 1922

August 21, 1894, cash on deposit, State Bank Safe Deposit Co., Boston	$ 5,564.48	
Cambridge Savings Bank	287.31	
		$ 5,851.79
Collections:		
Interest on securities	33,901.10	
Interest on bank deposit	11,838.71	
Life memberships	19,180.00	
Subscriptions, gifts and patrons	4,467.00	
Pasteur fund	100.00	
Transferred from funds Permanent Secretary by order of council	5,000.00	
Research funds	87,178.95	
Revertments	275.00	
		$161,940.76
		$167,792.55

Disbursements

August 21, 1894 to September 30, 1922

Grants	$ 29,741.45	
Life memberships	8,300.21	
Jane M. Smith fund	1,450.00	
Securities	121,414.77	
Purchased interest	826.58	
Rental safe deposit box	90.60	
Pasteur and other funds	300.00	
		$162,123.61
Cash in Banks:		
Fifth Avenue Bank of New York	$ 4,397.60	
U. S. Trust Company of New York	1,271.34	
		$ 5,668.94
		$167,792.55

FINANCIAL REPORT OF THE PERMANENT SECRETARY FOR THE FISCAL YEAR, 1922

October 1, 1921 to September 30, 1922

Receipts

To balance from last account:		
Checking account	$ 5,840.11	
Savings account	4,355.09	
Petty cash	7.81	
		$10,203.01
To receipts from members:		
Annual dues, previous to 1921	$ 168.93	
Annual dues, 1921	887.50	
Annual dues, 1922	50,764.69	
Annual dues, 1923 (paid in advance)	363.00	
Entrance fees	1,204.87	
Life membership fees	1,500.00	
Associate fees	1,150.39	
		$56,039.38
To other receipts:		
From treasurer's office:		
For life members' journal subscriptions	$ 1,029.00	
Special grant appropriation	500.00	
Sale of publications	770.00	
Postage, exchange, overpayments, etc.	706.23	
Interest on bank account	142.59	
		$ 3,147.82
Total		$69,390.21

Disbursements

By publications:		
Science Press		$32,161.46
By divisions, local branch and academy expenses:		
Divisions	$ 1,275.00	
State College (Pa.) local branch	52.00	
Remitted to affiliated academies on account of affiliation arrangements	1,328.00	
		$ 2,655.00
By expenses, general secretary's office		160.95
By expenses, permanent secretary's Washington office:		
Salary, permanent secretary	$ 2,500.00	
Salary, assistant secretary	1,000.00	
Salary, executive assistant	2,610.00	
Usual clerical help	2,230.00	
Office and addressograph supplies	222.47	
Printing and stationery	1,791.68	
Telephone and telegraph	256.28	
Travel expenses	1,919.07	
Postage (billing and correspondence)	769.23	
Express	52.35	
Miscellaneous	326.40	
		$13,677.48
By expenses, circularization:		
Affiliated societies and *American Men of Science*	$ 2,124.04	
Medical men (New England)	682.82	
Local committee, Toronto meeting	188.78	
		$ 2,995.64
By expenses, Toronto meeting:		
Travel expenses, W. Bateson	$ 300.00	
Preliminary announcement	1,124.11	
Messenger service (biologists)	16.50	
Refund for expenses incurred by section secretaries	134.29	
Miscellaneous	21.50	
		$ 1,596.40
By miscellaneous expenses:		
Refunds on account of overpayments	$ 427.73	
Bad checks	10.25	
Summarized proceedings and membership list (vol. 67-73), 1921	5,430.43	
Life membership fees	2,600.00	
Salt Lake City meeting	450.32	
Committee on grants for research	48.47	
Conference on Federation of Biological Societies, at Woods Hole, Massachusetts	100.00	
		$ 9,067.20
Total disbursements		$62,314.13

To new balance:			
Checking account		$ 1,078.40	
Savings account			
Emergency fund	$4,497.68		
Publication fund (for proceedings)	1,500.00		
		5,997.68	
			7,076.08
Total			$69,390.21

AUDITOR'S REPORT

Mr. Burton E. Livingston,
Permanent Secretary,
American Association for the Advancement of Science,
Washington, D. C.

Dear Sir:

Having been appointed auditor for the association for the year 1922, I have employed Mr. W. R. Gallaher, an accountant at the Interstate Commerce Commission, to go over the accounts of the permanent secretary for the year ending October 1, 1922. He makes the following report:

November 17, 1922.

This is to certify that I have carefully examined the records of all receipts and disbursements, in currency, checks, etc., of the permanent secretary's office of the American Association for the Advancement of Science for the year ending October 1, 1922, and have found the records correctly kept. Proper vouchers were shown for all disbursements.

(Signed) W. R. GALLAHER,
Examiner of Accounts.

I have reason to believe that Mr. Gallaher is an experienced and reliable accountant and that the above statement is a dependable report on the state of the accounts which were audited.

Very truly yours,
(Signed) ROBERT B. SOSMAN,
Auditor

Washington, D. C.
1 December, 1922

NOTE ON THE PERMANENT SECRETARY'S FINANCIAL REPORT

It is to be noted that a balance of $10,203.01 was carried forward from the fiscal year 1921 and that the corresponding balance at the end of the fiscal year 1922 is $7,076.08. The operations of the last year have therefore resulted in a decrease in the balance, amounting to $3,126.93. In this connection, however, it is to be noted also that the cost of printing the 1921-volume of "Summarized Proceedings and Membership List" was all met from the current funds of the fiscal year just ended, although none of this expense is properly chargeable to that year. The cost of printing the proceedings volume is shown as $5,430.43, which is greater by $2,303.50 than the amount ($3,126.93) by which the balance was decreased as above mentioned. From these considerations it appears that the decreased balance is due simply to the fact that the cost of printing the volume (properly chargeable against the preceding seven years and not to the year 1922 at all) has been wholly paid from the current funds for 1922. The 1922 balance of income above *current* expenses at the end of the fiscal year 1922 is really $7,076.08 *plus* $5,430.43, or $12,506.51, which represents an *increase* in the current balance amounting to $2,303.50.

A recurrence of this contingency is now being guarded against by the accumulation of a publication fund, to be formed by setting aside about $1,000 from the current funds each year, and it is planned that this fund will be sufficient to cover the cost of the next proceedings volume, to be published in 1925. At the end of the fiscal year 1922 the publication fund amounted to $1,500, and this has subsequently been increased to $2,500 by the setting aside of $1,000 from the current funds for 1923.—*B. E. L.*

BUDGET OF PROSPECTIVE EXPENDITURES

By the Permanent Secretary's Office, for the fiscal year 1923

Journal subscriptions	$32,500.00
Divisions	1,300.00
Local Branch	50.00
Academies	1,350.00
Salaries: Permanent secretary	2,500.00
Assistant secretary	1,000.00
Executive assistant	2,700.00
Clerical help	2,280.00
General secretary's expenses	250.00
Travel expenses	2,000.00
Office and addressograph supplies	225.00
Stationery and printing	2,000.00
Telephone and telegraph	275.00
Postage (billing, correspondence)	800.00
Express	50.00
Annual meeting	1,500.00
Circularization	1,500.00
Life membership fees, to treasurer	1,000.00
Miscellaneous	1,614.00
Committee on grants	50.00
Exchange on checks	33.00
Transfer to publication fund for Proceedings volume	1,000.00
Transfer to general emergency fund (interest on savings bank account for preceding year)	181.00
Total	$56,158.00

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THE HISTORY OF CHEMISTRY IN AMERICA WITH REFERENCE TO YALE[1]

I AM indeed grateful for the opportunity of speaking to you on the "History of chemistry in America with reference to Yale." This is an epoch occasion, and while we rejoice in the possession of this magnificent, palatial edifice, designed for the service of chemistry, it is well in this moment of exultation to take a backward look and note the

> rock from whence we were hewed and the hole of the pit from whence we were digged.

So that, with your permission, I shall briefly touch upon facts

> pick'd from the worm holes of long vanish'd days and from the dust of old oblivion rak'd.

Chemists—American chemists—in tracing the history of their science, are apt to turn to other countries. For chemistry was born in the dawn of civilization and to older lands one looks for its gradual evolution. As the oldest of the experimental sciences, it is coexistent with man's own rise and development. One need not search far to find evidences of its presence. Yet, Americans have frankly admitted their ignorance of the earliest days of chemistry in this western world. In fact, it has only been within the last quarter of a century that any effort has been put forth to ascertain when chemistry had its beginnings among us and what contributions it has made to the upbuilding of society.

It is to Jamestown, Virginia, founded in 1607, that the student of the history of chemistry must go, for there in the year 1608, before the ring of the axe was heard in the forests of America, bold spirits erected a glass house "in the woods" producing a product which was sent home in crude form, but still proof of the possibilities of an industry which might contribute to the maintenance of the settlement and to the coffers of the mother land. Glass beads made in that glass house exist to-day, showing that this product of chemical activity had for its purpose a means of effecting trade with the aborigines, who were attracted by the pearly, colored objects. And in 1619 two or three furnaces for the reduction of iron ores were in operation not far away.

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[1] Address at the dedication exercises of the Sterling Chemistry Laboratory at Yale University, April 4, 1923.

Chemistry was rapidly serving man in this then distant land at a day less than a century and a quarter after its discovery by the immortal Columbus. What more might have been accomplished in addition to the extraction of coloring matter from new plants, in addition to the isolation of substances possessing medicinal virtue, can only be conjectured, for further attempts were frustrated by the frightful, appalling massacres perpetrated by the Indians in 1622. The glass house and furnaces were completely demolished. Dead was chemistry in its applications at Jamestown.

To the Old Bay State the student must next go. For there it was that John Winthrop, the younger, a graduate of Dublin, an early member of the Royal Society, inaugurated chemical work by the development of ore industries which he carried far along in the state of Connecticut, of which he became the first governor. He held frequent correspondence with scientific friends in London. At their suggestion, and following, too, his own thought, he experimented widely, bringing to light many highly interesting facts afterwards placed upon the pages of the *Proceedings* of the Royal Society. As an associate of the leading alchemists of England, as a believer and promoter of the art of transmutation of the baser into the nobler metals, he breathed into the atmosphere about him the spirit of the projector or alchemist; and traces of that spirit continued far into the eighteenth century, subtly enchaining a son of Yale, born in New Haven, a minister of the Gospel, a lawyer, and again a preacher of the Word, and finally seventh president of Yale—*Ezra Stiles.*

It is he who must be regarded as Yale's first promoter of chemistry. In existing records it is noted, among other things, that Stiles repeated Priestley's experiments on fixed air; that he impregnated water with it, thereby making artificial "spa water"; and that in his leisure moments, generally at night, he tried certain reagents and wrote:

> If spirits of sea salt or the muriatic acid be drawn over the semi-metal called mangenese, it becomes a solvent of gold.

This fact had been mentioned by a Mr. Jones, who delivered a chemical lecture in New Haven. And from this same Mr. Jones, Stiles had received a quantity of vitriolic æther which apparently engaged his study for quite a little while. He observed that

> the æther imbibed a solution of gold and the next day when commixt with the *aqua regia* was again separated and held the gold distinctly separated.

All this while Stiles was reading Macquer's "Chemistry," from which he made a selection of experiments, performing them with more or less success, always at night. He was truly an enthusiastic student of chemistry. Men who had had experience in the science visited him and together they held discourses on chemistry and made inquiry concerning the hermetic philosophy. Stiles was in ecstasies when Dr. Eneas Munson, of New Haven, showed him a piece of malleable, whitish metal "which he himself made within a month past. It was fixed mercury, the first I ever saw," said Stiles.

One gathers from the notes of Ezra Stiles that in addition to his many duties as president and professor in Yale, his fondness for chemistry led him to speak of it and of the remarkable discoveries, unfolded through its agency, to his classes. He corresponded with Franklin, whom he idolized, and to him he gave account of his practical work in the science. Self-trained, it is but natural that he should have presented his subject in a crude form. There is also no question but that the matter of projection or transmutation was in his mind. He endeavored to free himself from it, with but partial success, for he was the intimate of Dr. Munson, Judge Danforth and the Reverend Mr. West, of whom he said:

> They believed in the reality of the Philosopher's Stone, although neither of them ever obtained it.

And in his diary occur these words:

> Terra Fol, æthere sublatâ hodie.

Absolute proof that he was really dabbling in alchemy! And yet, perhaps because in the thought of most people alchemy, the black art, belonged with witchcraft, Ezra Stiles did not care to be allied with those who practiced the latter. He was perturbed, and a little suspicious of himself, exclaimed:

> I am not versed in the books of the adepts. I have seen but a *few of these authors and read* less. Perhaps all the little I have read collectively would not equal a common octavo volume. I am infinitely less acquainted with them than any other of the sciences in the whole encyclopedia. I have never observed the extracted sulphur of gold *in terra*. I have no practical knowledge of the matter; the few ideas I have about it are only *imaginary, conjectural and speculative. Coram* Deo Veritas.

Dear old Dr. Ezra Stiles! We rejoice that you turned from witchcraft, which looks backward, but are profoundly thankful that you were, despite your lovely disclaimers, allied with alchemy, which looks forward; for truly it was experimental science in the making, a science that does not yet acknowledge its finite bounds, "but aspires, star-eyed, to illimitable possibilities." Yes, you were Yale's first experimenter in the science which has called us together this morning, and may your benign, fatherly spirit at this moment rest approvingly upon all who are here rejoicing with Yale in this new abode of chemistry.

Time rolled on. The soul of Ezra Stiles went out on the lonesome trail, and another son of Yale, who like Stiles became a lawyer, but animated by the latent purpose of the dear old alchemist in his predilection for chemistry heeded the call of *alma mater,* in 1802, to the chair of chemistry. Before assuming its duties, however, he journeyed to Philadelphia, then the center of art, literature and science, that he might sit at the feet of James Woodhouse, the Napoleon of experimental endeavors in America. Let us for a few moments follow this eager, earnest student—Benjamin Silliman, the elder.

What a delightful company awaited him in his lodging house in the city of Brotherly Love: Horace Binney, Charles and Elihu Chauncey and Robert Hare—young men of great prominence—educated men—men of elevated position in society, their manners in harmony with their training. Silliman wrote:

> As Robert Hare was a brewer of porter and was one of our number, his porter was in high request, and, indeed, it was of an excellent quality. He was a genial, kind-hearted person, a year younger than myself, and a proficient in chemistry upon the scale of that period. Hare invited me to join him in the study of his oxy-hydrogen blowpipe.

While perceiving that this instrument was ingenious, Silliman saw that it was unsafe as regards the storage of gases, and its correction in this particular was entirely due to him.

It was a genuine pleasure for Silliman to stand by his friend Hare in 1802 when the latter repeated his blowpipe experiments before Dr. Joseph Priestley, James Woodhouse, Thomas Cooper, Adam Seybert and others. One wishes that he might have a picture of that group!

The possibilities of the oxy-hydrogen flame were constantly in the thought of Silliman, and the very first pneumatic trough, including Hare's blowpipe, was constructed by Silliman *for the laboratory of Yale College in 1803.* In later years he wrote:

> The fusion and combustion and complete dissipation of platinum, gold, silver, nickel, cobalt and most of the metals, and the fusion of the principal earths and of their more refractory compounds have been made familiar and easy class experiments of every course of chemistry in Yale College for years.

Silliman and Hare were pupils of Woodhouse, who, when interrogated upon the brevity of his didactic lectures, replied

> that no man could dwell in discussion on a single topic more than five minutes without talking nonsense.

They were acquainted with his laboratory and the remarkable experimental work conducted by him, but in their leisure hours did very independent thinking and experimenting in their own laboratory in the basement of their lodging house.

To them it was delightful and profitable to meet Dr. Priestley very frequently at the home of Wistar. As Silliman was taking a broad view of science and its teachings, his hours with Wistar, the anatomist; Barton, the botanist, and Seybert, the mineralogist, were precious. In his mind were revolving brilliant schemes for the elaboration of all these subjects side by side with his thoughts on chemical research.

His friendship with Hare was unique. From their correspondence, continuing through life, it may be inferred that they were believers in and real promoters of genuine experimental science. They discussed its possibilities to and fro, and mutually submitted plans for the elucidation of the chemical and physical problems which interested them. While their active coexperimentation ceased upon Silliman's return to Yale in 1804, they wrote many letters regarding their common love—chemistry.

Silliman began his teaching career in a subterranean lecture room fitted up for his laboratory, which was fifteen or sixteen feet below the surface of the ground. It was inconvenient! It was so gloomy—but there he courageously worked for fifteen years. There he analyzed minerals and meteorites and invented and perfected apparatus for demonstration purposes in chemistry and physics. In 1805 he was off again. This time to Europe, meeting in London Frederic Accum and Humphry Davy; and in Edinburgh, John Murray and Thomas Charles Hope, the polished, stately and formal gentleman who succeeded the gifted Joseph Black. In Edinburgh, Silliman fairly reveled in the teachings of the Wernerian and Huttonian geological schools. He grasped the prevalent geological thought. But in 1806 returned to New Haven, his days of tutelage passed and his actual teaching career begun. Mineralogy, geology and pharmacy were added to chemistry. He proved a most inspiring teacher and founded in 1818 that splendid medium of circulating the scientific work of his colleagues and himself—the *American Journal of Science and Arts*, now in its one hundred and fifth year; and further he was prominent in the establishment of many Yale activities, flourishing at this moment—the art gallery, the astronomical observatory, the medical school and the Sheffield School of Science.

But to look once more upon Silliman as a research chemist. His *fidus Achates*, Robert Hare, had devised an unusual battery—a plunge battery of powers not before suspected. Hare transmitted all his experiences with this instrument to Silliman and even sent him a well-constructed *deflagrator*, as it was termed. Both experimenters marvelled at the occurrences on attaching carbon rods to the deflagrator and studying the arc which ensued. In March, 1823, just one hundred years ago, Silliman wrote Hare:

> I gave you . . . an account of the fusion and volatilization of carbon by the use of your galvanic deflagrator. I have now to add that the fusion of plumbago (black lead) was accomplished *yesterday* by the same instrument.

Again Silliman sought to ascertain the behavior of diamonds in the oxy-hydrogen flame, and said:

> They exhibited marks of *incipient fusion.*

And thus it continued. Should the thought enter the mind of any one that Silliman was not a producer in his favorite science, let him read the voluminous correspondence which passed between him and Robert Hare. He will then promptly assign him a high place among researchers. The story of his laboratory would make a good prelude to the history of university education in this country as distinguished from collegiate.

Silliman possessed the genuine instinct of discovery, the quick recognition of new and interesting facts, and enthusiasm in following them up to novel and important results. That his successes in other directions somewhat overshadowed them does not detract from their permanent value

> for it must not be forgotten that those who smooth the road to science and facilitate its acquisition to others are often more permanently useful than such as are supereminently learned themselves; the greatest personal or mental acquirements die with the possessor; but those who labor that others may be wise are a benefit to all posterity (Mavor).

Is it not to the inspirational teaching of Silliman that American science is indebted for Dana, world-renowned geologist and mineralogist; Brush, whose exhaustive mineralogical chemical studies are authoritative everywhere; Johnson, pioneer leader in chemistry applied to agriculture; Willard Gibbs, first among physical chemists of modern times; T. Sterry Hunt, profound in chemical philosophy and theory, and hosts of others—giants in the world of natural and physical science?

Last evening I stood "under the friendly silence of the moon" before the bronze figure of Benjamin Silliman out on yonder campus; how I wished that I might speak out my thoughts to you! I did whisper to him:

> To you, revered master, we are indebted for this magnificent laboratory. Your spirit, mysteriously conveyed to your successors in order, caused science—particularly chemical science—to so permeate the curriculum of Old Yale that the

subterranean laboratory has been brought to the surface, enlarged, developed and endowed, that its rays may illuminate the world—far and wide.

We chemists here assembled say to Yale that we are not envious—no, we are happy, felicitating you with all our hearts and with you thanking God

that Silliman, the elder, was born.

While to President Angell, I'd add:

As one arranges in a simple vase
A little store of unpretending flowers,
So gathered I these records of past hours,
And trust them, honored sir, to thy grace.

EDGAR F. SMITH

PSYCHOLOGY AS A LIFE WORK

THE student facing the choice of his life work should consider two matters with especial care. These are his abilities and interests on the one hand and, on the other hand, the opportunities that are offered by a profession for personal development, public service, and the respect of those whose respect is most worth while to him. Ability and interest are personal. Their true estimation requires self-criticism and the advice of those who know one best. The opportunities that a profession offers may be learned from the candid statements of experts in the field.

The field of psychology.—Psychology is primarily the science of human experience, behavior and personality. It reaches down into childhood and animal life. It reaches out into the abnormal and the unusual, to depravity and genius. A sound psychology is needed in medicine and the social sciences, in religion and art, in education, law and politics, in industrial management, vocational guidance and social service. It is involved in our attempts to answer some of the greatest riddles of the universe, such as the relation of brain and mind, the origin of intelligence, and the basis of right conduct. It seeks to know the sources and organization of experience and motives, the integration of human personality, and the bonds that connect us with our fellows. Every phase of human feeling, thought and action from birth to death belongs to the field of psychology in as far as it is capable of scientific observation, description and analysis.

Prerequisites to a career in psychology.—The first prerequisite to a career in psychology is a systematic knowledge of its tradition. This is generally initiated by an elementary course which introduces the student to the entire field. It should be supplemented by courses in analytical psychology, genetic psychology, comparative psychology, physiological psychology and social psychology. In addition, the student should gain as extensive laboratory experience as is practicable. Command of the French and German languages is a necessary auxiliary since a large part of the scientific literature is published in these languages. The student who chooses psychology for a career should have a good foundation in philosophy, mathematics, biology, physiology, physics and chemistry. Courses in applied psychology should vary according to the interests of the student. They should be supplemented by thorough study of the several fields to which they relate.

Elementary work in psychology is provided for in every well-equipped college of liberal arts. For his advanced study the student who wishes to specialize in psychology should go to that university whose faculty most nearly meets the needs of his special interests.

Types of careers in psychology.—As in most of the sciences, there are three main types of careers in psychology. These are teaching, research and applied psychology. Of these three, teaching is the only standardized career at the present time. It is usually the base from which one may develop research or applied psychology. Teachers of psychology are employed in colleges and universities, normal schools and some other technical schools. There is room not only at the top but all along the educational line for intelligent, thoroughly trained and devoted teachers of psychology. All such can be certain of earning a living and rendering human service the value of which can not be measured in dollars.

A teacher of psychology should always be more or less of an investigator. This is probably true of all teachers. Unless one appreciates scientific problems as he meets them and tries to collect data for their solution he can scarcely appreciate the meaning of science, its evolution and the dangers that beset scientific generalization. Moreover, he will miss the joy that comes to the explorer who pushes the dark boundaries of the unknown a little further away. It would, however, be disastrous for a teacher of psychology to supplant the great scientific traditions by his narrow lines of investigation.

Careers of pure research unmixed with other duties are rare in any field of science. They are especially rare in psychology and can scarcely be held out as an exclusive aim in the choice of psychology as a profession.

Applied psychology.—The applications of psychology are as numerous as human endeavors. Applied psychology, however, is still in its infancy though it has rendered notable service in several directions. Self-supporting careers may at present be found in educational psychology, in clinical psychology and in industrial and business psychology. Each of these lines will be described by an expert in the field. None of these divisions of applied psychology is standardized or developed to a point where one can rest content with present methods and results. In addition to a thorough grounding in his field of science and in the field of its application, an applied psychologist needs ingenuity, initiative and administrative ability. For those who possess the requisite qualities and training there is no limit to public service and financial rewards.

RAYMOND DODGE

WESLEYAN UNIVERSITY

EDUCATIONAL PSYCHOLOGY

The most common career for a man or woman qualified in educational psychology is to teach in a department or school of education in a university or in a normal school. The qualifications are the same as for teachers in institutions for higher education in general, except that more skill and care in teaching itself is expected, and that a knowledge of the theory and practice of education is desirable.

There is an increasing demand for experts in psychological and educational measurements to work in the educational department of a state or city or in large private institutions. Such a position will usually be distinct from that of the clinical psychologist to be described later, though in some communities, one person will be responsible for both kinds of work. General scientific ability, knowledge of educational practice, industry, adaptability and good sense, are the most necessary qualifications. Mathematical insight, ability to organize a mass of details, and ability to manage children in interviews and tests are desirable.

In so far as he uses his undergraduate studies to prepare himself for either the teaching or the practice of educational psychology, the student may favor courses in physiological psychology, educational psychology, tests and measurements, the psychology of childhood, elementary education, secondary education and educational administration. His graduate studies should, if possible, include thorough work in individual psychology (including the psychology of exceptional children and the technique of standard tests), the psychology of the elementary school subjects and the theory and practice of psychological and educational measurements.

EDWARD L. THORNDIKE

TEACHERS COLLEGE,
COLUMBIA UNIVERSITY

CLINICAL PSYCHOLOGY

The rapidly growing appreciation of the value of psychological facts and principles in directing individuals who are poorly adjusted to their environments has opened up many lines of psychological research and practice. The federal government, state institutions and individuals are seeking psychologists to devise and apply tests to determine many things besides retardation, chiefly individual exaggerations, idiosyncrasies, aptitudes, tendencies and capabilities, with special reference to the prevention of adverse happenings and to the prediction of probable means of successful adjustments. This field is, therefore, closely bound up with educational, occupational and social applications of psychology, and also with the physical side of life which is cared for by the medical practitioner. It will be appreciated that preparation for practice or research in this field involves some acquaintance with the facts of disease from both the physical and mental sides, as well as with the means of treatment and their limitations and interrelations. Practice and research also require the physician's mental attitude; sympathy but not sentimentality, an interest in the welfare of the individual and of society which over-balances a natural shrinking from diseased states or the seamy side of life, and an understanding of the frailties and foibles of man. For the psychologist with special training and aptitudes the opportunities in private work or in institutional employ are not surpassed financially or scientifically by that in any other field.

SHEPARD I. FRANZ

ST. ELIZABETH'S HOSPITAL,
WASHINGTON, D. C.

CAREERS IN INDUSTRIAL PSYCHOLOGY

The world of business and industry is not exactly clamoring for psychologists to come and show how factories should be operated, offices organized and sales increased. Indeed, hardly more than one or two men are earning a livelihood in industry to-day as *psychologists*.

There are, to be sure, several trained psychologists who are ably filling business positions—in personnel administration, industrial training, business analysis, sales promotion and management and advertising. Their duties, however, are much like those of other executives who may have studied only in the school of actual business experience. The doctor of philosophy who specializes in industrial psychology can not be confident of a chance to earn his living practicing the applications of his science in a business concern. He should first fit himself for university teaching and research, for this is the main trunk from which branch the opportunities for careers in industrial psychology.

Three outstanding assets for a career in industrial psychology are: a sound training in scientific method; the capacity to be genuinely interested in all sorts of people and the personality to deal effectively with them; and superior practical judgment, especially where money values are concerned.

It is a common error to imagine that an industrial psychologist does not need to be exacting in his scientific ideals and rigorous in his procedures, as does the experimentalist in a university laboratory. When selecting psychological methods for practical use—in an employment office, for example— he must know and evaluate all the considerations of reliability of one method *vs.* another, and *in addition* he must be able to evaluate relative costs in comparison with returns in dollars. For this reason it is essential for the industrial psychologist to have a good grounding in economics, including cost-accounting and industrial management. Mastery of the technique of constructing and administering tests is also of secondary importance, except as it may serve as a discipline in scientific method. The bulk of the training must be in general systematic psychology and in statistical and experimental method. To be an industrial psychologist one must first of all be a psychologist.

For the young man or woman, then, with a strong bent toward practical psychology, the first objective should be to secure the training necessary for doing good teaching and research in general and experimental psychology. Later, when one has made his place in a university or a research bureau as a teacher or an assistant investigator, the psychologist who combines practical good sense with scientific thoroughness and with ingenuity may be certain of finding opportunities in any industrial community for working on the most fascinating practical problems. His financial rewards will then be proportionate to his resourcefulness and his ability to produce an output of cash value to industry.

W. V. BINGHAM

CARNEGIE INSTITUTE OF TECHNOLOGY,
PITTSBURGH, PA.

EDWARD WILLIAMS MORLEY

EDWARD WILLIAMS MORLEY was born in Newark, N. J., January 29, 1838. His parents were the Reverend Sardis B. Morley and Anna Treat Morley. Soon after his birth they moved to Hartford, Conn., and thereafter for the next twenty-five years his life was spent in New England. He graduated from Williams College in 1860, and from Andover Theological Seminary in 1864, and later taught in the South Berkshire Institute at Marlboro, Mass. He also spent a few years as minister in the Congregational church. In 1868 he married Isabella Ashley Birdsall, of Winsted, Conn., and a year later was called from the pastorate of the Congregational Church in Twinsburg, Ohio, to be professor of natural history and chemistry in Western Reserve College, then located in the neighboring town of Hudson. Later the college was moved to Cleveland and became Adelbert College of Western Reserve University.

During the first years at Hudson Professor

Morley taught not only chemistry and physics but also mathematics, mineralogy, geology and botany. Chemistry was always, however, his chief interest, and he at once had a small room fitted up as a chemical laboratory, where, as one of the early catalogues states, "The class perform, under the guidance of the professor, all those experiments which are suitable for them, while those which demand more experience are performed for the class by the teacher." A course in quantitative analysis was also given at this early date.

Morley was always a tireless worker. In 1873 he also became professor of chemistry in the medical department of the college in Cleveland, which necessitated his spending much time in traveling back and forth between the two towns. In addition he was always engaged on some research and besides undertook analytical work for certain industrial firms in order to obtain funds to finance his needs for special apparatus and books, the college not being able in those days to afford to purchase supplies except those actually required by the students. After the college had moved to Cleveland in 1882 and had acquired a greater endowment, he was able to devote himself to teaching chemistry exclusively and in 1888 to give up his connection with the Medical School. In 1898 the trustees of the college voted that, in consideration of his great scientific achievements, sufficient assistance would be provided so that he could do as little teaching as he wished and devote his time to research. He, however, chose to continue most of his teaching, and taught general chemistry and quantitative analysis until he retired as professor emeritus in 1906.

Professor Morley prepared altogether fifty-five papers for presentation before scientific societies or for publication. His first work of importance, undertaken while in Hudson, was on the relative proportion of oxygen in the air (1878-81). In the course of this he devised and constructed an apparatus for determining the proportion of oxygen in the air rapidly and with great precision. He made analyses of the amount of oxygen in the air on 110 consecutive days in order to accumulate data bearing on the so-called Loomis-Morley hypothesis, which was put forward to account for the variation of the oxygen content of the air with the change of barometric pressure. According to this hypothesis deficiency of oxygen was supposed to occur at times of high barometric pressure, due to downward currents bringing air from high altitudes to the surface of the earth. He summed up his results in the following words: "The theory that deficiencies in the amount of oxygen in the atmosphere are caused by the descent of air from an elevation fairly well agrees with the facts."

The outstanding labor of his life, and for which Morley is best known among chemists, is his work on the density of oxygen and hydrogen and the ratio in which they combine. He was occupied with this during most of the twelve first years he spent in Cleveland and had it ready for publication in 1895. It came out as Smithsonian Contribution to Knowledge, No. 980, and also appeared in German in the *Zeitschrift für physikalische Chemie.* This research placed him in the very first rank of scientists. In it one sees his remarkable insight into the fundamental nature of the problem, his great skill in devising and manipulating apparatus, his precision of measurement and his great patience and perseverance in overcoming obstacles at times seemingly insurmountable. It is a remarkable tribute to his work that now, after nearly thirty years, the accepted values of these quantities, which are the averages of the best recent work in this field, are practically identical with those found by him.[1]

Many other papers published by Morley during or after this period were the results of work bearing on this central problem, as, for example, "On the amount of moisture remaining in a gas after drying with sulfuric acid," "On the amount of moisture remaining in a gas after drying with phosphorus pentoxide," and "On the vapor tension of mercury at ordinary temperatures."

He devised a gauge for measuring small differences of gaseous pressure. This was of two types, one of which he used in collaboration with Professor D. C. Miller in determining the thermal expansion of air, nitrogen and a few other gases, and the other with Mr. C. F. Brush, by means of which differences of gaseous pressure as small as one ten-thousandth mm. of mercury could be measured.

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[1] To consider the density of oxygen alone: in the annual report of the Committee on Atomic Weights for this year (1923) the average of recent determinations is given as 1.42892, which is identical with Morley's figures when reduced to the same standard.

Professor Morley was as eminent a physicist as chemist. His characteristic for precision of measurement is exhibited by his early papers on "Rulings on glass" and "The probable error of micrometric measuremeents." After coming to Cleveland he collaborated with Professor Michelson in the development of the interferometer, an instrument for measuring lengths in terms of the wave-length of light. With this instrument they undertook their well-known experiment on the relative motion of the earth and the luminiferous ether, which was carried on at the same time as the research on the densities of oxygen and hydrogen. A little later with Professor W. A. Rogers he perfected a method for measuring the expansion of metallic rods with the interferometer. After the work on oxygen and hydrogen was out of the way he again resumed the experiments on the drift of the ether with Professor D. C. Miller. Although these experiments yielded negative results as far as the expected magnitude of the motion was concerned, they aroused a great deal of interest, and Professor Miller has since repeated them under more favorable conditions at Mount Wilson Observatory. Professors Morley and Miller also made use of the interferometer in measuring the velocity of light in a magnetic field.

Professor Morley with all his greatness was by disposition of a most retiring and modest nature, almost too much so for his own good, as he was but little known outside the ranks of chemists and physicists. He was in no sense a self-advertiser. However, after the completion of the work on oxygen and hydrogen in 1895 honors were showered upon him. He was president of the American Association for the Advancement of Science in 1895, and of the American Chemical Society in 1899. In 1901 he was the American delegate to the General Conference on International Weights and Measures in Paris. Previously, under the Harrison administration, he was one of the four members at large of the committee to receive the United States Prototype Metric Standards at the White House. In 1907 he was awarded the Sir Humphry Davy Medal by the Royal Society of London, in 1912 the Franklin Institute of Philadelphia conferred upon him the Elliot Cresson Medal, and in 1917 he received the Willard Gibbs Medal from the Chicago section of the American Chemical Society. In 1912 he was honorary president of the Eighth International Congress of Applied Chemistry. He received honorary degrees from many universities: LL.D. from Western Reserve in 1891, from Williams in 1901, from Lafayette in 1907, from the University of Pittsburgh in 1912, and D.Sc. from Yale in 1909. He was an honorary member of the Royal Institution of London, the Chemical Society of London and the American Chemical Society. In addition to this, he was a member or fellow of the National Academy of Sciences, the American Philosophical Society, the American Society of Arts and Sciences and of many other learned societies in this country and abroad.

Professor Morley realized the importance of books in enabling one to keep abreast of the work being done in one's science. Since the college was unable to purchase books for him, he began at an early date to collect a library of the principal chemical journals and by the time he had completed his work on oxygen and hydrogen he owned personally one of the most complete sets of journals on pure chemistry to be found between New York and Chicago. He even purchased a number of Russian journals and learned to read this language so as to gain at first hand knowledge of certain researches which interested him in that country. On his retirement in 1906 the college purchased this library from him. It is now housed in the chemical laboratory, built in 1908-1909, for which he drew plans, and which is now known as the Morley Chemical Laboratory.

Professor Morley in general enjoyed good health and was possessed of remarkable vitality. But no constitution could withstand with impunity the strain of long hours and hard work which he continually imposed upon himself up to 1895. This so impaired his health that he felt obliged to rest, and he was granted by the college a year's leave of absence (1895-1896), the only one during his entire career. This he spent in travel and recuperation abroad. After this the college authorities granted him more assistance, so that he took life easier and was able to enjoy some of its amenities.

Next after research he enjoyed exercising his skill on difficult chemical analyses, and during his last years in Cleveland he analyzed many complex minerals for his friend and colleague, Professor H. P. Cushing, who spent a portion of his time with the New York Geological Survey. After he retired from active teaching in 1906 and went to live in West Hartford, Connecticut, he built for himself a small laboratory where he still continued making analyses of this sort for Professor Cushing and for other friends interested in geology. His last published paper was with Professor J. P. Iddings on work of this kind.

Professor Morley had a remarkably retentive mind, so that practically everything which he read was stored in his memory, whence it could be drawn whenever needed. He not only possessed a remarkable clarity of expression in writing and speaking, but what is rarer, he had the ability to make scientific and abstruse matters interesting to the layman. His public lectures on such subjects as the ether-drift experiments were always well attended and every one manifested the keenest interest in what was being said.

He was a great lover of music and a good amateur musician. In the early days he played the chapel organ at Hudson, and in his later life derived much enjoyment from the pianola. After his retirement this versatility was a great help to him in getting the most enjoyment out of life. When he became weary at his analytical work, he would turn to music for relaxation. He also took a great deal of pleasure in out-of-door life, raising gladioli or taking trips through New England in his automobile, which he always drove himself. Only last summer he and Mrs. Morley, whose death preceded his by only a few months, took a trip into northern Massachusetts and Vermont in their machine.

He was taken to the Hartford Hospital for an operation on January 21. Another operation was found to be necessary about three weeks later, which was not serious and from which he was expected to recover. Unexpected complications, however, set in and the end came on February 24, just a few days after his eighty-fifth birthday.

Thus in the fulness of years passed a truly great man. The work he left behind him in both chemistry and physics is the best memorial to his genius. His teaching service extended over a period of thirty-seven years and endeared him to several generations of students. By his colleagues he was revered for his genial personality, the wisdom of his counsel and his unselfish service. His broad culture and noble simplicity of character enriched the lives of all those with whom he was associated.

OLIN FREEMAN TOWER

WESTERN RESERVE UNIVERSITY

SCIENTIFIC EVENTS

INTERNATIONAL CONFERENCE ON STANDARDIZATION OF SERUMS[1]

IN December, 1921, an international health conference was held in London, under the auspices of the League of Nations, to discuss the standardization of serums and serum reactions; in December, 1922, a second conference for the same purpose was held in the Pasteur Institute, Paris, at the suggestion and under the chairmanship of Professor Madsen, president of the health committee of the League of Nations. Professor Neufeld, director of the Robert Koch Institute for Infectious Diseases, Berlin, who, with Wassermann, Kolle and Sachs, took part in the conference, gives a report of the proceedings in the *Deutsche medizinische Wochenschrift*, January 5, 1923. The transactions were carried on by subcommittees. The first dealt with the standardization of tetanus and diphtheria antitoxins. These investigations are nearly complete, and it is expected that an agreement will soon be reached as to a generally acceptable method of titration and standardization. Heretofore, not only have other countries used standards (immunity units) different from those of Germany, but there have been fundamental differences in titration. For example, in France, not only is Ehrlich's procedure used for the titration of diphtheria serum (combinations of toxin and antitoxin), but the effect on living diphtheria cultures is also tested.

A second subcommittee took up the question of dysentery serum, which, with us, is not required to be tested. It is certain that many unfavorable observations on dysentery serum in Germany have been due largely to the use of defective serums, and that results would be improved by a standard titration approved by the state public health service. Investigations of the antitoxin test on rabbits and mice are still being carried on.

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[1] From the *Journal* of the American Medical Association.

The largest subcommittee, under the chairmanship of Bordet and Wassermann, discussed the serodiagnosis of syphilis, and several reports were read on comparisons between the original method of complement fixation, and the flocculation or precipitation methods of Sachs-Georgi, Meinicke and Dreyer. These investigations are to be continued in certain definite directions by one laboratory of each of the several countries. In Germany there have been many complaints of evils arising from the serodiagnosis of syphilis, and, in consequence, an attempt was begun last year to prevent as far as possible the injuries and untoward effects that may arise from the improper application of this delicate and practically important procedure, by adopting an officially recognized and uniform method of application of the Wassermann test. This regulation has encountered considerable opposition, especially from directors of laboratories, and it is hoped that the investigations of the health committee of the League of Nations will be of great value in preparing a revision of existing regulations, which will be necessary before long.

Two other subcommittees are engaged in investigation of the antipneumococcus and the antimeningococcus serums, respectively. With regard to the former, the subcommittee expressed the opinion that an opinion as to their efficacy would at this time be premature; however, we possess reliable methods of titration, and if antipneumococcus serums of high value according to these standards are tested in pneumonia cases which are not too far advanced, we may expect, within a reasonable time, a final and reliable judgment on the value of this form of serotherapy.

With the antimeningococcus serums, serotherapy is likewise much complicated by the fact that there are several different types of causative agent, and corresponding variations in antibodies. In Germany the state has already established standards for meningococcus serum. These standards, however, give no consideration to the different serologic types, and there is therefore need for revision. Cultures and serums of the various types of organisms are being exchanged by the laboratories conducting the investigation, and the question as to what antibodies (bacteriotropins, antiendotoxins, agglutinins, antibodies causing complement fixation) shall be used to establish the titer of a given serum is being studied according to definite standards set up by the committee. We should await the results of these investigations before we revise the official standards in Germany. This is an exceedingly important, practical question; for, in the opinion of Professor Neufeld, the antimeningococcus serum is possibly the most effective therapeutic serum yet used in the treatment of human diseases.

THE STANDARDIZATION OF SCIENTIFIC SYMBOLS AND ABBREVIATIONS

A recent conference held in New York City under the auspices of the American Engineering Standards Committee revealed a sentiment among engineers, scientists, government officials, business paper editors and industrial executives, emphatically in favor of the unification of technical and scientific abbreviations and symbols.

It was agreed on all sides that the standardization of abbreviations and symbols would result in inestimable mental economies. The present situation with respect to the use of abbreviations and symbols in engineering, scientific and other technical fields is comparable to a language which has degenerated into a multiplicity of dialects, each of which has to be translated for the users of the others. Abbreviations and symbols constitute an ever-growing and important part of the language of engineers, scientists, industrial editors and other technical men. The use of one symbol or abbreviation for several different terms and the use of several different symbols or abbreviations for one meaning are, however, at present causing a great deal of confusion, misunderstanding and often serious errors.

The conference was called upon requests from the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Association of Edison Illuminating

Companies, to consider abbreviations and symbols, but after some discussion of the subject it was thought desirable to include as a part of the project the graphical symbols which are used in engineering drawings, diagrams and the like, for representing instruments and apparatus and components of them.

It was agreed that the cooperation of foreign standardizing bodies should be sought in the development of the work. The importance of international uniformity in symbols is great on account of the international character of much engineering and scientific work, and the importance of reference books and periodicals in foreign languages.

The work will go forward under a committee organization developed in accordance with the rules and procedure of the American Engineering Standards Committee.

The appended list of those who attended the conference and the organizations by which they were designated will show the diversity of interest involved in the project.

Henry Norris Russell, American Association for the Advancement of Science.

Sullivan W. Jones, American Institute of Architects.

Edward J. Cheney, American Institute of Electrical Engineers.

George W. Metcalfe, American Institute of Electrical Engineers.

C. H. Sharp, American Institute of Electrical Engineers.

Edward K. Judd, American Institute of Mining and Metallurgical Engineers.

Edward V. Huntington, American Mathematical Society.

Albert P. Wills, American Physical Society.

Henry A. Ruger, American Psychological Association.

G. A. Newrath, American Railway Association—Signal Section.

C. L. Warwick, American Society for Testing Materials.

Stanley F. Morse, American Society of Agricultural Engineers.

C. B. LePage, American Society of Mechanical Engineers.

Sanford A. Moss, American Society of Mechanical Engineers.

C. M. Sames, American Society of Mechanical Engineers.

R. R. Leonard, American Society of Refrigerating Engineers.

R. D. Parker, American Telephone and Telegraph Company.

C. H. Sharp, Association of Edison Illuminating Companies.

H. Stuart Acheson, Combustion Publishing Corporation.

H. G. Knoderer, Electrical Manufacturers Council.

A. M. MacCutcheon, Electrical Manufacturers Council.

L. A. Hazeltine, Institute of Radio Engineers.

Howard Richards, Metric Association.

Kenneth H. Condit, National Conference of Business Paper Editors.

Alexander Maxwell, National Electric Light Association.

Charles E. Neil, National Electric Light Association.

W. Spraragen, National Research Council.

Sullivan W. Jones, National Research Council Engineering Division.

John T. Faig, Society for the Promotion of Engineering Education.

Sanford A. Moss, Society for the Promotion of Engineering Education.

John M. Lloyd, Society of Automotive Engineers.

W. W. Smith, Society of Naval Architects and Marine Engineers.

J. Franklin Meyer, United States Bureau of Standards.

Ray M. Hudson, United States Department of Commerce.

A. W. Whitney, chairman, American Engineering Standards Committee.

P. G. Agnew, secretary, F. J. Schlink, assistant secretary, American Engineering Standards Committee.

BOARD OF SURVEYS AND MAPS

A report of the Board of Surveys and Maps of the federal government for the calendar years 1921 and 1922, dated March 5, 1923, and signed by William Bowie, chairman, has been submitted to the President of the United States.

The board was created by executive order dated December 30, 1919, and was designed to furnish the means of coordinating the activities of bureaus and independent organizations of the federal government engaged on surveying and mapping, to avoid duplication of effort by these organizations and to make the results of the greatest usefulness to the map using public. The report gives the list of the eighteen government organizations having representation on the board and the list of the twenty-two non-governmental organizations represented on the advisory council which was created to assist the board in making contact with the public.

At each public meeting, which is held bimonthly, there have been present members of the advisory council and others who are not members of the board. The report states that the meetings have been well-attended and that there has developed a remarkable spirit of helpfulness and cooperation which has led to very beneficial results. Various bureaus of the government dealing with surveying and mapping look to the board for advice on technical matters. Several cases of cooperation have resulted from the close contact in the meetings of the representatives of the various surveying and map making bureaus. Notable examples are:

1. Cooperation between the corps of engineers and the United States Geological Survey in the topographic mapping needed by the various branches of the Army;
2. Cooperation of the Air Service of the Army and the Topographic Branch of the Geological Survey;
3. Cooperation of the United States Geological Survey and the United States Coast and Geodetic Survey with the Forest Service and with the Bureau of Soils in furnishing surveying and mapping data to the latter two organizations;
4. Cooperation between the United States Coast and Geodetic Survey and the General Land Office which has resulted in the connection of corners of the land surveying system of the country with the triangulation stations established by the former bureau.

In obedience to the executive order creating the Board of Surveys and Maps, a central map information office was established in the Interior Building for the purpose of collecting, classifying and furnishing to the public information covering all mapping and surveying data available at the several government departments and from other sources. This map information office has been of the greatest assistance to the government and to outside organizations and individuals. Much information has been furnished by it to all branches of the government service, to universities, schools, map publishers, commercial firms of all kinds, state officials, individuals of foreign countries and to the general public. The results accomplished by the map information office alone justify the creation of the Board of Surveys and Maps of the federal government.

While the Board of Surveys and Maps was not created to engage in the task of securing more funds for the several surveying bureaus in order that the topographic mapping of the country might be expedited, yet the members of the board feel that the mapping of the country should be taken up as a project and that legislation looking towards this desirable result should be enacted by congress. In the opinion of the board, the demands made on the bureaus of the government furnishing surveying and mapping information amply justify the appropriation of the necessary funds to extend the mapping at a more rapid rate than has obtained in the past.

W. BOWIE

EXECUTIVE BOARD OF THE AMERICAN ENGINEERING COUNCIL

DECISION to undertake a nationwide coal storage investigation was reached by the executive board of the American Engineering Council of the Federated American Engineering Societies at its meeting at Cincinnati, March 23 and 24. General endorsement of the plan for government reorganization, submitted to congress with the approval of President Harding and the cabinet, and continuance of the committee on Transportation, headed by Max Toltz, of St. Paul, were other outstanding features of the meeting.

The personnel of the committee to conduct the coal inquiry, which is to be made unless there is objection from the constituent societies, will be announced later by President Cooley.

The committee on procedure of the American Engineering Council some weeks ago authorized the appointment of a committee on transportation for the specific purpose of investigating and reporting to the executive board as to what, if anything, the American Engineering Council could do with propriety and effectiveness in relation to the transportation problem of the American people. The committee was instructed that it was to give consideration to all forms of transportation, that is, by railways, by motor trucks and by water.

Max Toltz, chairman of the committee appointed, made a progress report to the executive board, pointing out many of the important phases of the very complex problem. He stated that the task was such a large and ramifying one that the committee would require more time in which to advise the executive board what, if anything, it should do. He further indicated that probably the best service the American Engineering Council could render would be to cooperate with a number of national organizations which has been working in this field for years.

J. Parke Channing, of New York, chairman of the new committee on government reorganization as related to engineering matters, made a progress report indicating the active participation of the federation in this sphere.

Concerning the registration of engineers, the following resolution, moved by Gardner S. Williams, of Ann Arbor, Michigan, was adopted:

> Resolved, That it is the sense of this executive board that American Engineering Council should continue to collect and keep up to date a record of the engineers registration and licensing laws that may be proposed or passed, together with decisions thereunder for the use of the constituent societies of the Federated American Engineering Societies and others, but that it assumes no control over the actions of such constituent societies in regard thereto.

The executive board voted to cooperate in the movement to bring about uniform safety legislation, to broaden the program of its reforestation committee, to study the question of constituting the American Engineering Council a clearing house on elimination of waste, to further American participation in the proposed world power conference in London in 1924 and to work with the National Safety Council in plans for Conservation Week.

The sessions of the executive board were held at the Ohio Mechanics Institute, an inspection of which was made by the members of the board under the guidance of President John T. Faig. On the evening of March 23, the board members were the guests at dinner of the Cincinnati Engineers Club. Following the dinner there was a public meeting, President Cooley presiding. Speakers included Dr. Ira N. Hollis, L. W. Wallace, J. Parke Channing, Calvert Townley, O. H. Koch and several prominent Cincinnati engineers. The formal decision of the Indiana Engineering Society to enter the federation was announced by its president, W. H. Elliott, city engineer of Indianapolis. The speakers agreed that the federation was proving itself an effective instrumentality of organized engineering, that it would continue to make durable progress and that its permanence was virtually assured.

It was voted to hold the next meeting of the executive board in St. Paul, Minnesota, from June 8 to 9.

THE LOS ANGELES MEETING

THE seventh annual meeting of the Pacific Division of the American Association for the Advancement of Science, to be held in conjunction with a summer session of the American Association for the Advancement of Science and the Southwestern Division at the University of Southern California, Los Angeles, September 17, 18, 19 and 20, promises to be a unique event in scientific annals. The occasion of this meeting in Southern California is primarily the total eclipse of September 10, which will draw to this locality astronomers from all parts of the world. It is estimated that over fifty visiting astronomers will be present besides the local contingent from Mount Hamilton and Mount Wilson Observatories.

Besides a meeting of the American Astronomical Society and the Astronomical Society of the Pacific, it is planned to arrange a symposium on some subject of astronomical interest.

Paleontology will also be featured in the general sessions, illustrated by the discoveries of the Rancho La Brea beds.

The Society of Petroleum Geologists is planning to hold a meeting, also the American Meteorological Society, the American Society of Economic Entomologists, the American Phytopathological Society and the American Society of Agronomy.

The American Chemical Society will be represented by the California Section and the Southern California Section, and the various affiliated societies of the Pacific Division and the Southwestern Division will be largely represented on the program.

Professor E. C. Franklin, president of the Pacific Division, American Association for the Advancement of Science, will preside over the general sessions and deliver the presidential address.

As a convention city Los Angeles offers many attractions. The mecca of tourists from all over the world, drawn by its balmy climate and picturesque surroundings, it is commercially and industrially one of the most important centers in the west. Its hotel facilities are unsurpassed. The accommodations for the meetings to be provided by the University of Southern California are extraordinarily well suited to the requirements. Large auditoriums for the general sessions and well-lighted commodious lecture halls for the scientific sessions are all housed in one building, a convenience which will be appreciated by all who have attended former meetings.

The preliminary announcement will be issued about June 1. Secretaries of sections and societies which are planning to hold meetings are urged to mail their announcements to the secretary, Golden Gate Park, San Francisco, not later than May 5 for inclusion in the preliminary announcement:

Following is a schedule of the sessions:

September 17, 1923. Monday morning: Meetings of affiliated societies. Monday noon: General session—research conference (12:15 to 2:00 P.M). Monday afternoon: General session—symposium on "Relativity" or some astronomical subject. Monday evening: General session—president's address by President E. C. Franklin and public reception.

September 18, 1923. Tuesday morning: Meetings of affiliated societies. Tuesday afternoon: Meetings of affiliated societies. Tuesday evening: General session—banquet and popular address.

September 19, 1923. Wednesday morning: Meetings of affiliated societies. Wednesday afternoon: Meetings of affiliated societies. A popular address may be arranged for this session by the local committee on arrangements.

September 20, 1923. Thursday: Excursions. Visiting members will be invited to inspect the equipment of Mount Wilson Observatory on this day.

W. W. SARGEANT
Secretary

SCIENTIFIC NOTES AND NEWS

DR. THEOBALD SMITH, director of the department of animal pathology of the Rockefeller Institute of Medical Research at Princeton, was elected on March 30 president of the American Association of Pathologists and Bacteriologists meeting in Boston. Other officers elected were: Dr. James Ewing of New York, professor at Cornell Medical School, vice-president; Dr. F. B. Mallory, director of the laboratory at the Boston City Hospital, treasurer; Dr. H. T. Karsner, professor at Western Reserve University, Cleveland, secretary.

THE French government presented the medal of the Legion of Honor to Dr. Victor C. Vaughan, on March 28, for meritorious service in science and in the world war. The decoration was presented at the Chicago Club by M. Barthelemy, the consul, in the presence of a few medical friends.

THE University of Arizona conferred the honorary degree of Doctor of Science on Mr. Henry Wallace, secretary of agriculture, on his recent (March 31) visit to Tucson. The only honorary degree previously awarded by the university was to General John Pershing.

THE University of Bordeaux has conferred an honorary degree on Professor Ramón y Cajal, the distinguished Spanish histologist. It is the first time a degree of the kind has been given by this university outside of France.

PROFESSOR M. W. P. BROEGGER, professor of geology at the University of Christiania, has been elected a foreign associate of the Paris Academy of Sciences, to succeed the late Professor Schwendener.

MAJOR GENERAL SIR WILLIAM B. LEISHMAN, director of pathology at the War Office, London, has been appointed to succeed Sir John Goodwin as director general of the British Army Medical Service.

DR. B. BARKER BEESON, Chicago, has been elected a corresponding member of the Paris Anatomical Society.

DR. JOSEPH MERRILL, dean of the Engineering College of the University of Utah, has been elected president of the Engineering Council of Utah, representing about fifteen hundred men of the engineering profession.

Frederick Laist, chief chemist Anaconda Copper Mining Company, was awarded the James Douglas medal at the recent New York meeting of Institute of Mining and Metallurgical Engineers, for achievements in non-ferrous metallurgy.

Mrs. Anna Botsford Comstock, professor of nature study at Cornell University, has been nominated for the position of alumni trustee.

Dr. Robert H. Bowen, of Columbia University, has been elected treasurer of the American Society of Zoologists to succeed Dr. D. H. Tennent, resigned.

R. T. Stull, chief ceramist, U. S. Bureau of Mines, has been granted a leave of absence to accept the appointment of assistant general industrial agent of the Central of Georgia Railway, Savannah, Ga. He will devote his attention to the development of the mineral resources of the region traversed by this railroad.

G. F. Moulton has resigned his position at the Bureau of Standards to accept a place as chemist of the research department of F. C. Huyck and Sons, Albany, N. Y.

After twenty-six years of service with the Solvay Process and Semet-Solvay Companies, in Syracuse, New York, Alexis C. Houghton has resigned his position as chief chemist to enter service of the Bakelite Company, of New York. He will have charge of its synthetic phenol plant.

Dr. Charles Moon, of Cornell University, has taken up work at the Bureau of Standards, in the section of induction and capacity, electrical division.

Sabbatical leave of absence for the purpose of travel and study has been granted by the University of California to five members of the College of Agriculture: Dr. Elwood Mead, professor of rural institutions; S. B. Freeborn, assistant professor of entomology; E. C. Voorhies, assistant professor of animal husbandry; W. Metcalf, associate professor of forestry, and G. W. Hendry, assistant professor of agronomy.

Dr. John H. Tanner, professor of mathematics at Cornell University, has a leave of absence during this second semester, which he is spending on a trip to Europe and the Near East.

Mr. N. Gist Gee, for twenty years professor of biology at Soochow University, China, has been appointed adviser on premedical education to the China Medical Board of the Rockefeller Foundation. He will make a study of the teaching of chemistry, physics and biology at colleges in China.

Dr. T. H. Morgan, professor of experimental zoology at Columbia University, gave three lectures at the University of Michigan on April 2 and 3, a public lecture entitled "Genetics and development" and two more technical lectures on genetics. On April 3 a luncheon was given in his honor.

On March seventeenth, Professor W. F. G. Swann, University of Minnesota, Minneapolis, delivered an address at Toronto to the Royal Canadian Institute on the subject "The earth's electric and magnetic phenomena."

Dr. Edgar Nelson Transeau, head of the department of botany at Ohio State University, gave four lectures on botanical subjects during the week of March 12th, at the University of Minnesota, under the auspices of the Plant Science Seminar and the Botany Club.

Some time ago it was announced in Science that a committee had been organized to collect subscriptions for a monument to the memory of Professor Yves Delage, which his former students and admirers propose to erect near the marine laboratory at Roscoff. A number of Americans have in past years worked at this laboratory, and all biologists are indebted to Delage for his discoveries in marine biology, his organization of zoological science and his book on protoplasm and heredity. As the time is approaching when the subscription lists will be closed, this matter is once more brought to the attention of the readers of Science. Subscriptions to the memorial may be sent direct to Mlle. L. Dehorne, treasurer of the committee, at the laboratory of zoology, Sorbonne, 1, rue Victor-Cousin, Paris, 5^{e}, or through any one of the American members of the committee, Frank R. Lillie, T. H. Morgan and Charles B. Davenport. Science is informed that any amount will be welcomed and should preferably be received before the middle of June next.

The American Association of Immunologists held its annual convention in Boston on March 28 and 29, under the presidency of Dr. George W. McCoy, surgeon-general of the United States Public Health Service.

THE American and Canadian section of the International Association of Medical Museums met last week in the Boston City Hospital. Officers were elected as follows: Dr. F. B. Mallory, *president;* Dr. H. T. Karsner, of Cleveland, first *vice-president;* Dr. H. E. Robertson, of Rochester, Minnesota, *second vice-president;* Major James Coupal, of Washington, third *vice-president; councilors,* Dr. A. S. Warthin, of Ann Arbor; Dr. James Ewing, of New York; Dr. W. G. MacCallum, of Baltimore; Dr. William Boyd, of Winnipeg; Dr. H. S. Haythorne, of Pittsburgh; Dr. Carl V. Weller, of Ann Arbor; Dr. Stuart Graves, of Louisville; Dr. G. R. Callender, of Manila, P. I.; Dr. L. J. Rhea, of Montreal; Dr. Oscar Klotz, of Toronto; Dr. H. Marshall, of the University of Virginia; *secretary-treasurer,* Dr. Maude E. Abbott, of McGill University; *assistants,* Dr. H. N. Segall and Dr. E. L. Judah, of Montreal.

THE fifth annual meeting of the American Society of Mammalogists will be held in Philadelphia from May 15 to 17. Sessions the first two days will be devoted to the reading of papers, discussion and business, and will be held from 10 A.M. to 4:30 P.M. each day in the Academy of Natural Sciences, Logan Square. A session may also be arranged for the evening of May 16. As a part of the general program it is planned to have a symposium on field methods, including all phases of the subject. On May 17 the society will visit the Philadelphia Zoological Gardens as guest of the Zoological Society. There will also be opportunities to visit other institutions of interest to members, and the usual social functions will be arranged. Headquarters will be at the Aldine Hotel, Chestnut Street above Nineteenth Street.

AT a representative meeting of botanists held at the Linnean Society's rooms on March 2, it was decided to hold an Imperial Botanical Conference of British and overseas botanists in 1924 about the beginning of July. An executive committee was appointed, with Sir David Prain as chairman; Mr. F. T. Brooks as honorary secretary, and Dr. A. B. Rendle as treasurer.

IT is stated in *Chemical and Metallurgical Engineering* that congress having failed to act on the proposal to increase salaries for chiefs of bureaus and scientific investigators in the Department of Agriculture, it has been determined to fill the vacancy in the office of chief of the Bureau of Chemistry at the earliest possible time. The place has been held open in the hope that a salary higher than $5,000 could be offered to those best qualified to fill the position. Dr. E. D. Ball, director of scientific work for the department, will appoint a consulting committee on which he hopes to induce some of the outstanding men in the chemical industry to serve. With this committee he will discuss not only the filling of the vacancy but the whole program of future work for the Bureau of Chemistry.

THE New York Academy of Sciences announces a prize of $250 offered by Mr. A. C. Morrison, fellow of the academy, to be known as the A. C. Morrison Prize for 1923 and to be awarded at the annual meeting on December 17. The conditions are: (1) Membership in good standing of the New York Academy of Sciences or one of the affiliated societies. (2) Papers are to be submitted on or prior to November 1. (3) The prize is offered for the most acceptable paper in a field of science covered by the academy or an affiliated society, which paper embodies the results of original research not previously published.

WILLIAM PHELPS ENO, of Washington, D. C., chairman of the board of directors of the Eno Foundation for Highway Traffic Regulation, Inc., has given Yale University $1,000 for three prizes of $500, $300 and $200 for students, to be awarded for a thesis supplemented by drawings on "The rotary system of traffic regulation and its application, with or without changes in curb lines, at foci or intersections of existing thoroughfares."

THE Richmond Pathological Society has appropriated $25 for a prize to be offered for the best original research work produced by undergraduate students of the Medical College of Virginia during each current year, the award to be made under conditions prescribed by a committee consisting of the president of the society, chairman; Dr. Cook, professor of pathology; Dr. Noback, professor of anatomy, and the secretary. First, the prize will be awarded at commencement time. Second, the applicant must be a *bona fide* undergraduate student of the Medical College of Virginia.

PROFESSOR NORMAN R. CAMPBELL writes to *Nature*: "Surely the time has come to abandon the practice of attaching to elements fancy names arbitrarily selected by individuals. When names concerned nobody but a small clique in constant personal communication, and when they had nothing more important to record about an element than the personality of its discoverer, there may have been something to say for the system. Now-a-days neither condition is fulfilled. Thousands are interested who have no means of expressing their opinion; and there is something definitely scientific to be said about elements. The new element was discovered as a consequence of a theory of the structure of the atom, and its discoverers should surely be glad to see a record left in the name that their discovery was no lucky fluke. Dr. Aston, who has discovered at least twice as many elements as anybody else in the history of science, has set a good example; he has waived his right of naming, undoubted under the old dispensation. He has left them unnamed until a consensus of scientific opinion has established a scientific system of nomenclature. Will not others follow his lead? Until its isotopic constitution is discovered, let us simply call the new element 72."

UNIVERSITY AND EDUCATIONAL NOTES

AT the University of Cambridge the admission of women students of Girton and Newnham Colleges to titular degrees in the university has now been approved. Among the other privileges granted to women students by the new regulations is included the right to be admitted to instruction in the university and to university laboratories and museums, though the number receiving such instruction at any one time is limited to five hundred.

THE chief engineer of the Westinghouse Electric and Manufacturing Company, Benjamin Garver Lamme; the engineer of the Philadelphia Electric Company, Paul Ortams Reyneau; and the superintendent of equipment of The All American Cable company, N. J. Perryman, will lecture at Yale this year to students in electrical engineering.

PROFESSOR W. S. WELLES has been made head of the Department of Agricultural Education at the Massachusetts Agricultural College to take the place of Professor William R. Hart, who retired on March 31.

PROFESSOR FODOR of the University of Halle, Germany, has arrived in Jerusalem to organize the plan for the biochemical institute of the Hebrew University of Jerusalem.

ADDITIONS to the endowment funds and gifts for current use amounting to about $1,200,000, received by the University of California since March 23, 1922, were read by President David P. Barrows at the annual Charter Day exercises. Four annual scholarships have been established at the Westinghouse Electric and Manufacturing Company, as a memorial to employees of the company and its subsidiaries who served in the world war. Each scholarship carries an annual payment of $500 for a period not to exceed four years, to be applied toward an engineering education in any technical school or college selected by the candidate. Scholarships are allotted by competitive examinations to (a) sons of employees in employ for five years or more; and, (b) employees continuously employed for at least two years and not over 23 years of age.

DISCUSSION AND CORRESPONDENCE

PROFESSOR LLOYD AND VEGETABLE CRYSTALS

PROFESSOR LLOYD attacks statements of mine regarding the formation of vegetable crystals, recently published in this *Journal*, because in his opinion they tend to invalidate views recently expressed by himself in the American Journal of Botany. The only reference made by him to the subject of crystals in that article is a brief one on page 157 which reads, "Chloroplasts and starch grains are usually present, and a large stellate crystal of calcium oxalate is frequently, though not invariably to be seen." This meager statement is all that appears in this connection. It does not appear accordingly that Professor Lloyd's amour propre has really been affected by my remarks on the subject of crystallization in plants. His later expressions make it clear that it is rather the reaction of the Tong than of the individual, which is involved.

I must unfortunately take exception to some of Professor Lloyd's statements of fact. His description of his methods indicates that they are rather crude and he fails to make clear the relation of the cells described either to the growing point or to the cambium. The assertion that more than one druse is found in a cell is, whether intentionally or not, misleading. I have examined many thousands of microtome sections of the tissues at the growing point, and in proximity to the cambium in Ginkgo and various Dicotyledons. These sections have been made in all three planes, radial, tangential, and transverse, and in no instance have I ever seen satisfactory evidence of the occurrence of more than one druse in a cell. The only exception mentionable in this connection is in the case of the so-called crystal sand, commonly found in cells of the Solanaceae, etc. Here there is frequently a *single* druse accompanied by a *number* of simple crystals, but my statement was in regard to druses alone. If more than a single druse occurs in any case it must be a very rare and unusual occurrence and consequently having little bearing on the general situation.

Professor Lloyd affirms that in Ginkgo the young druses are not over half the dimensions of the nucleus. The incorrectness of this statement can readily be demonstrated objectively by photomicrographs taken in the region of the growing point and of the cambium. In these juvenile regions the nuclei of the cells are always much smaller than the diameter of the druses. Professor Lloyd's criticism that the colloidal central body in the druses "lacks the support of general observability and so becomes insubstantial" seems to reveal an inadequate technique, for invariably after removing the crystalline shell of the druse by appropriate solvents, notably weak hydrofluoric acid, the central body can be readily stained. Professor Lloyd's comparison of the "insubstantial" nucleus of the crystal with the string inside the stick of "rock candy" has the shortcomings characteristic of many mechanistic analogies. The internal central colloid substance of the compound crystal, unlike the "string," increases pari passu with the growing volume of the druse and clearly exerts an active influence both on its conformation and increase in size. The central body in crystals is in fact not only both clearly observable but is likewise very far from being "insubstantial." One interesting result of the detailed examination of crystals with adequate technique is the discovery that many forms which have been thought to occur freely in the cavity of the cell are in fact cystoliths. Cystoliths of calcium oxalate appear in fact to be much more prevalent than the well known ones of calcium carbonate, from which they differ decidedly both in form and mode of origin. I must reiterate my statement that in the case of large druses, such as are common in Ginkgo and Carya, the growth of the compound crystal continues long after all peripheral protoplasm outside has disappeared. The expanding crystal in such cases clearly brings about not only the enlargement of the cell-wall but in many instances a reshaping of its configuration to correspond to the projecting spines of the contained crystal. The truth of this statement can easily be demonstrated by the objective evidence of photomicrographs. In comparing the growth of the crystal with the development of the coats of spores Professor Lloyd seems to deal with matters which are fundamentally different.

Finally I must state that I agree heartily with Professor Lloyd that "it still remains legitimate to use what we do know to explain what we do not," but this formula should be qualified by the reservation that we must be sure that we really know what goes on in the body of living beings before we attempt to make comparison with analogous chemical and physical conditions. The mechanistic highway is strewn with wrecks arising from the neglect of this consideration. We need only mention Sachs' long held fallacious demonstration that the water must pass up through the walls of the cells of the wood because it could not possibly make its way, on physical and chemical grounds, through the lumina or cavities of the tracheids and vessels. It may further be pointed out that no real progress was made in the study of the development of starch grains until Meyer began at the morphological end and proved that the layering was not due to any recondite physical or chemical causes as previously asserted, but rather to alternations of night and day. Such examples could be multiplied indefinitely.

It is an interesting feature of the study of religions that converts are always the most bitter assailants of the views they once held. Extremely good illustrations of this principle can be supplied from the ranks of the morphologists, who in recent years by reason of faith or expediency have turned to physiology or genetics. The set of the biological tide has however again turned towards morphology and in the near future we are likely to have abstruse problems, both genetical and physiological, receive needed light from this quarter. Nor has the fundamental biological study of the origin of species passed, as was predicted years ago, from the field to the laboratory. The field is still much more important. Experiments *in vitro,* whether in glassware or greenhouses, need to be interpreted in the clearer atmosphere of the world outside. This situation was doubtless in Professor Conklin's mind when he recently called attention to the relatively slight evolutionary results, flowing from the huge experimental activities of the past twenty years.

E. C. Jeffrey

COLORED HEARING

The following incident seems to have several points of interest:

Fulton (aged three years, 11 months, listening to the phonograph): "Daddy, I think soft music is yellow."

Dr. P. (his father, a distinguished chemist): "Yellow? And what color is loud music?"

Fulton: "Well, it is black."

Dr. P.: "And what is blue music like?"

Fulton: "Blue music is loud, but not so loud as black music."

Dr. P.: "Tell me, why is soft music yellow?"

Fulton (after thinking a moment): "Well, when you mark with yellow crayon on paper, you can't see it very well, but when you mark with black, you can."

Dr. P. had read an article in Science about colored hearing and explains his interest in his son's remark by the fact that it seemed to suggest a possible hypothesis as to the origin of such phenomena. The first point to notice, therefore, seems to be that there is a distinct value in such a journal as Science with its appeal to scientific men of all complexions.

For there are certain regions in which the psychologist as well as the biologist is in much the position of the astronomer, of having to wait for phenomena to occur under non-experimental conditions. Even if colored hearing could be experimentally induced, we should have little guarantee that it is the same as that "normally" possessed by many persons. It would be unduly tedious for psychology to have to wait for such evidence to be collected solely by psychologists from the observation of their own children, even were they as a class far more fecund than is the case.

The suggestion of the incident is, of course, that such associations between sounds and colors might be gradually strengthened while the connecting link dropped out of sight. Dr. P. is carefully avoiding any suggestion to the child and, at a later date, an attempt will be made to see whether the association has developed or has disappeared.

Have other readers of Science relevant observations?

Horace B. English

Antioch College

ACETONE IN TISSUE WORK

I was much interested in Professor F. M. McFarland's note (Science, July 14, 1922) on the use of acetone in place of alcohol in preparing paraffin sections for microscopic examination. Essentially the same method has been used in the laboratory of the Clinic for about two years. Merck's acetone, U.S.P., is used. The steps in staining the slides are passing them through a series of Coplin jars as follows: two of xylene, two of acetone, one of water, one of hematoxylin, one of distilled water, one of tap water, one of acetone, one of acetone saturated with eosin, and two of xylene. The results appear quite as satisfactory as when alcohol is used in passing to and from water. State and federal regulations and restrictions for obtaining alcohol together with the high internal revenue tax make its use almost prohibitive. In calling attention to the suitability, if not superiority, of acetone as a decolorizer in Gram's method of staining bacteria I briefly referred to the suitability of acetone in the process of staining sections (*Journal* of the American Medical Association, Volume 75, page 1017, October 9, 1920). Of course the well-known use of acetone in dehydrating preparatory to embedding is also employed.

M. W. LYON, JR.

SOUTH BEND, INDIANA

WEALTH AND BENEFACTIONS

Now comes Dr. Pritchett with the hint that accumulated wealth can not even be *given away* to the benefit of the public. And the question is—what ground is left on which to defend large fortunes? Socialists have always declared against them. The one defense which they have never quite gotten round is that wealth makes benefactions possible and supports the public good in a way that this could not be done—or *would* not be done—by small contributions or general assessment. Millions of curses on the octopus have been checked by the thought that—perhaps, after all— . . . . considering the universities— . . . . and then there's the science of medicine— . . . . and then to think of art— . . . . and after all we do need *philanthropists*— . . . . Without such thoughts as these, who would defend the poor rich man? Mr. Pritchett does not tell us whether he will or not. The evident gloom of spirit in which he writes shows that he is groping after truth (not a bad thing to grope after). It might even indicate a fear that when the truth is found it may be disagreeable. It surely would be if it told us that our standard argument for great fortunes is mere *buncum*.

But this question just now is before scientific men. How will they handle it? Presumably if the accepted solution proves false others will be tested. At least the problem will be analyzed. What are the alternatives? If money can not safely be given away in large sums, how about small sums? The corrupting effect might thus be distributed so that no one man or institution would suffer so much. As an extreme supposition the whole fortune might be turned into the public treasury and every man's tax bill decreased accordingly.

Of course, the fortune might be left to one or more heirs (presumably incapable of corruption). In this case the fund might either endow a permanent aristocracy or the problem might be solved by the wasting of the money. Neither of these solutions would find many champions among thoughtful men.

To suggest that the rich man should give away his own income or accumulations does not help. Mr. Pritchett's report does not assume that the injury done by gifts is in any way determined by their immediate source.

The one remaining choice would seem to be to manage a very lucrative business in such a way that profits shall be distributed as earned among all concerned and even shared with the public by reducing prices when their size becomes unseemly. This, of course, is rank labor unionism and has been answered a thousand times by men of good "business judgment" who are accumulating fortunes. It is only mentioned here to complete the list of possible solutions.

The writer of this modest inquiry finds himself groping among these possible alternatives for a solution that is better than the one employed hitherto. He would like to see some incomes, now derived from *private taxation*, reduced to the point that ledger accounts could be published without scandal, but beyond that his fear of socialism almost makes him willing to incur the risks of injury which attend the acceptance for his own institution of a share of that embarrassing money of which Mr. Pritchett writes, rather than see our rich men rush into "untried experiments."

Meantime, he wishes to say that the above paragraphs are not written in jest. The difficulties suggested in Mr. Pritchett's report may be more real than we like to admit, and in that case the alternative solutions must be faced. What if Mr. Pritchett and the socialists were both right?

MODEST INQUIRER

QUOTATIONS

RESEARCH AND TEACHING

I HAVE recently been reading the programs of the meetings of representative American learned societies and it is astonishing to find the rapidly growing numbers of the communications which originate with the employees of the great business activities of the country. These papers are by no means wholly of an applied or utilitarian character. There is an abundance of pure science, of abstract discussion, obviously encouraged by the business administrations in question. In other words, the promotion of pure science has been acknowledged as exceedingly good business. The American business man has been quick to appreciate the value of research, once its meaning was brought home to him, and he is now enthusiastic in opening new paths to hiding-places of nature. That such paths are apt to lead undeviatingly from his own private domain is here of secondary importance.

The reaction of all this on the professor may well be looked at with misgiving. The college in the future, as heretofore, will necessarily insist on the primary importance of teaching. Instructors come to us with functionally well-equipped brains, aglow with the brightness of a young man's ardor, strong in the beautiful hope of achievement and with youth's illusions all undimmed—only to be forever confronted by the elusive response of the average student. Nothing is so deadening as the prolonged contact with the uninformed, the indifferent; for it keeps a low standard of comparison always in view. Eventually a man will measure his own mental stature by its elevation above that humble level. If the incentives to a stimulating competition, to an emulation among professional compeers, are also lacking, the distortion of intellectual values may be complete. A persistent urge, like a physical field of force, however weak, is a very dangerous agency. Watching sleeplessly, like Satan, over the course of things, it may even convert a faculty of high aims and specifically equipped scholarship into a body of schoolmasters. The exalted obligation incident to exceptional training is creative, an enlargement of the boundaries of knowledge, a new voice in art; but its fruition may degenerate into some academically dignified clerkship. A mute inglorious Darwin may be detecting new group affinities among old courses, or piecing together the parts of some academic picture puzzle. It is not the strong bias, but the monotonous continuity of petty bias that quenches. At some instant of flickering the sacred flame is blown out.

In the end, I fear, the trusts, as we fondly call them, will have absorbed and assimilated *l'élan vital,* the soul of the university. It is they who will point out to our bewildered gaze the sweep of new horizons and the flotsam from undiscovered shores. Our faculties will have to teach what they have been taught by the great business corporations. These will hereafter break new pathways into the unknown, and it will be for us to tell the uninformed the Ultima Thule of their progress. The university will be the humble expository mechanism of the intellectual accomplishments of commercial enterprise. In brief, there will be a complete inversion of the method by which the world's knowledge has deepened in the past.

If one looks, for instance, at the highly ingenious contrivances by which the marvels of the Hertzian wave have recently been brought to the appreciation of the people, one is struck by the appearance on every clamp, every ferrule, every coil, every tube, almost on every plate and screw of the mysterious symbol, PAT. This PAT. is a cipher more potent than any formula of Cagliostro. It is behind an array of PAT. that the wisdom of the future will be entrenched, and above which so much of it as may be vouchsafed us will be broadcast. Our function will resemble the town crier's, to herald the information somebody else has wrested from the infinite. We shall still be interested and keenly watchful, no doubt, like the little cherubs with wrapt gaze at the feet of the Sistine Madonna; but the great inspiration will float majestically above us.—*Dean Barus in the annual report of the president of Brown University.*

THE TECHNICAL PAPERS OF THE NATIONAL GEOGRAPHIC SOCIETY

THE National Geographic Society announces a series of technical papers embodying the scientific results of its Katmai, Alaska, expeditions. The first number entitled "The origin and mode of emplacement of the great tuff deposit of the valley of ten thousand smokes," by C. N. Fenner, is now ready.

Dr. Fenner's paper gives details of the hot sandflow not included in the nontechnical volume, "The valley of ten thousand smokes," by the writer, recently published by the National Geographic Society.

This series of papers from time to time will embody researches in diverse fields of science resulting from National Geographic Society expeditions. Notices of their appearance will be sent to all who desire such notification. The papers themselves will be distributed only to those who specifically request them.

An abstract of Dr. Fenner's paper follows:

The valley of ten thousand smokes is filled with a thick deposit of fragmental material, which was extruded during the great eruption of 1912. Although similar in composition to the ashfall from Katmai, this material evidently flowed down the valley under gravity like a liquid. At the time of its extrusion it was highly heated, for all vegetable matter which it touched was completely reduced to charcoal.

Several lines of evidence indicate that this tuff could not have come from the crater of Katmai: (1) The slopes down which it would have flowed are covered with a large glacier whose surface bears no indication that an avalanche of hot material passed over it. (2) The topographic relations of the several parts of the deposit make it practically impossible that Katmai crater or any other single source (either outside the valley or within its borders) could have supplied the material to all areas that it covers.

It is concluded, therefore, that the tuff must have come from a number of vents, and further inquiry reveals no other probable source than the fissures that have disrupted the valley floor (and to a less degree, the floor of Katmai Pass and the lower slopes of Trident) and are now marked by lines of fumaroles.

At the time of its extrusion the temperature of the material was sufficiently high not only to carbonize tree trunks but probably to produce secondary explosions where it came into contact with streams of water.

The extrusion of this material preceded the explosion of Katmai, as its surface is, in general, covered by the ashfall.

Most of the material is a highly silicious glass, inflated into pumice or shattered to fine dust, but mingled with this is a considerable amount of basic pumice and scoria, together with fragments of old andesites, sandstone and shale. The old basic rocks have been much digested by the new magma, producing great quantities of banded pumice in which both old and new components are easily distinguishable. The sediments are attributable to the Jurassic strata that underlie the valley everywhere, but the source of the old volcanics is more of a problem.

Something of the conditions of digestion of the old lavas can be learned from a study of Novarupta volcano, the largest vent in the valley, which is now plugged by a "dome" of highly viscous lava. A large amount of old basic lava evidently became involved in the newly rising silicious magna and was melted down by it. The author believes that the source of this old basic material was derived from the morainal deposits rather than from bed rock below the vent.

It is thought that the best explanation of the practical restriction of fissures to the valley floor is that a sill-like wedge of magma was intruded between the horizontal strata underlying the valley and produced by its upheaving action a block-like fragmentation of the roof where thinnest. The fractures then served as orifices of extrusion for portions of the magma.

The surface outburst seems to have behaved very much like the *nuées ardentes* of Pelée and La Soufrière and to have spread as a hot sandflow through the valley. A surprising feature is the extremely low angle of repose (little more than 1 degree) finally assumed. This and other features seem best explained by supposing that evolution of gas from the magma continued during the movement of the sandflow and was the central feature of it. The characteristics of this form of eruption and the factors to which they are due are discussed in some detail.

SPECIAL ARTICLES

THE PRECIPITATION OF METALS BY HYDROGEN SULFIDE

In connection with Professor Neuhausen's[1] appreciative discussion of a note of mine[2] on the precipitation of metals by hydrogen sulfide, I desire at this time to call attention to a newly discovered instance which appears to have a significant bearing on the subject. This, of course, is merely a preliminary notice; the details of an extensive investigation concerning the interaction of hydrogen sulfide and metallic salt solutions, which is being carried on in collaboration with Mr. Waldo L. Semon, will, it is hoped, be ready for publication within the next year or two.

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[1] Science, Vol. LVII, No. 1462, p. 26, (1923).

[2] *J. Am. Chemical Soc.*, 44, 1500 (1922).

As a starting point, the reader is requested to call to mind the white precipitate, whose intermediate formation is always observed when hydrogen sulfide is passed into a solution of mercuric chloride strongly acidified with hydrochloric acid; and which may also be prepared by treating freshly precipitated mercuric sulfide with a solution of mercuric chloride. The composition of this white substance is represented by the formula, $HgCl_2 . 2\ HgS$; and the analogous double nitrate, $Hg(NO_3)_2 . 2\ HgS$, is a familiar substance, as well. Formally, at least, these compounds are analogous to the addition products of mercuric chloride with organic sulfides, as $HgCl_2 . 2\ S(C_2H_5)_2$.

In the writer's opinion, all these compounds are complexes, more or less analogous to the well-known platinum complexes, $[Cl_2Pt(SR_2)_2]$, $[Pt(SR_2)_4]Cl_2$, etc.; and it is thought probable that their formation may be a consequence of the previous formation and decomposition of unstable addition products of mercuric salts with hydrogen sulfide itself, or of the intermediate ions of such salts with hydrosulfide-ion, or both. But, unfortunately, the transitional mercuric double salts in question are insoluble, or else very unstable, and therefore they do not readily yield to investigation. For that reason, we have sought in many ways to prepare soluble inorganic compounds of this nature.

Apparently, we have met with some success in working with mercuric perchlorate, $Hg\ (ClO_4)_2 . 4H_2O$. This salt was prepared by dissolving mercuric oxide in an appreciable excess of perchloric acid, followed by evaporation to a small volume, and crystallization. It should be noted that mercuric perchlorate in its reactions resembles mercuric nitrate rather than the chloride, and that perchloric acid and hydrogen sulfide do not interact in aqueous solution.

The Interaction of Mercuric Perchlorate and Hydrogen Sulfide, and of Mercuric Perchlorate and Mercuric Sulfide.—Freshly prepared (approx. 0.08 molal) hydrogen sulfide solution was slowly run from a burette into a solution of 2.0 g. of crystalline mercuric perchlorate in 25 cc. of water. Each drop produced locally a flocculent black precipitate, *which quickly redissolved on shaking.* The reagent was run in with shaking, in 1 cc. portions, as long as the precipitate continued to redissolve. The clear, colorless liquid soon acquired a brownish opalescence, but nevertheless it continued to redissolve the precipitate, more and more slowly, as produced, until in all about 32 cc. of the hydrogen sulfide solution had been added. The further addition of the reagent yielded a permanent precipitate, which however showed no tendency to settle until the further addition amounted to 26 cc.; even then, the clear supernatant liquid gave no test for hydrogen sulfide until the further addition amounted in all to 28 cc. It is seen, therefore, that about 60 cc. of the reagent was required for the complete precipitation, and that of this quantity about one half was consumed in each phase of the reaction. The latter observation was confirmed by the following experiment.

The black precipitate, obtained as above from 2.0 g. of mercuric perchlorate, was freed as far as possible from the supernatant liquid by decantation, after which it was washed twice by decantation with water. It was then treated with a solution of 2.0 g. of mercuric perchlorate in 30 cc. of water, added in small portions, with shaking; the whole quantity was required in order to just redissolve the black precipitate. The resulting solution was transparently clear, with a brownish opalescence, and left only a trace of residue upon filtration. The behavior of the solution thus formed is of considerable interest, especially in connection with the formation of the well-known white precipitate, $HgCl_2 . 2\ HgS$, which is observed as a transition product in the precipitation of mercury by hydrogen sulfide in the presence of chlorides.

Small portions of the freshly prepared solution were found to give white precipitates with sodium chloride or hydrochloric acid, nitric acid and sulfuric acid—all containing mercury and sulfur, and presumably of the compositions represented by $HgCl_2 . 2\ HgS$,

$Hg(NO_3)_2 . 2\ HgS$, and $HgSO_4 . 2\ HgS$. The bulk of the solution, upon standing overnight in a small stoppered flask, deposited an almost white precipitate, and the supernatant liquid contained only mercuric perchlorate and perchloric acid. This precipitate, which can readily be obtained pure and white, was found to correspond in composition to the formula, $Hg(ClO_4)_2 . 2\ HgS$. It will be more fully described in a future publication.

In conclusion, it is desired to emphasize that the solution obtained by the interaction of 2 mols of mercuric perchlorate and 1 mol of hydrogen sulfide, or of one mol each of mercuric perchloride and sulfide, contains a complex salt which on the one hand reacts with soluble chlorides, nitrates and sulfates to yield more or less insoluble precipitates, and on the other hand spontaneously decomposes in accordance with the equation, $2[Hg(ClO_4)_2 . HgS] = Hg(ClO_4)_2 . 2\ HgS + Hg(ClO_4)_2$.

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EFFERENT CHARACTERISTICS OF RECEPTION CENTERS

THE peripheral efferent nerves of mammals arise as axones of cells having a definite type of structure, a structure characterized by the arrangement of the Nissl substance within the cell in large sharply defined granules. Other efferent cells closely related to the peripheral efferent neurones have been shown by Jacobsohn to present much the same type of structure, and in a previous article I have described the location of these cells in various regions of the brain; such cells may be termed premotor to express their functional and structural relation to the peripheral motor cells.

Further study convinced me that due to the complex relations within the central nervous system a rigid classification of nerve cells into types would offer little hope of elucidating the functional significance of cell structure. We do not know what determines the structure of a nerve cell, but it must be related at least partly to the stimuli which the cell receives. Since the activity of the central nervous system consists essentially of diffusion of impulses through diverse paths and recombination into new paths it is evident that, while in some cases the total stimulus to two nerve cells may be practically identical or else very different, in many cases two cells may receive stimuli which are similar in some respects but different in others. I consider cell activity (function) and cell structure (together with size and form) as complexes and have attempted partially to analyze each of them, observing under what functional conditions a certain character of cell structure constantly appears in cells otherwise structurally different. Thus the structural characteristic of efferent cells is the presence of relatively large and discrete Nissl granules, while the large size and polygonal form which such cells often exhibit are not directly related to their efferent function but to other aspects of cell activity.

Having isolated from the complex of cell structure the element corresponding to the efferent tendency it was then possible to identify this structural character in cells known to be more remotely related to the musculature than are the peripheral efferent cells or those pre-motor cells closely related to them; and as the relation of the cell to the peripheral efferent neurones became more remote the cell showed a corresponding change in the efferent character of its structure, the Nissl granules becoming smaller and often less sharply defined. In studying the more remote efferent cells I was finally confronted with the fact that many so-called sensory centers contain at least some cells with a structure as characteristically efferent or even more efferent than that of certain undoubted efferent cells. This efferent character of cell structure as revealed in reception centers of the human brain and cord will now be considered.

Our knowledge of reception centers for general proprioceptive sense is limited largely to those related to the spinal nerves. The peripheral efferent column of gray matter is a reception center for general proprioceptive impulses involving the simpler reactions, and the failure formally to include it among the proprioceptive reception centers has tended to obscure the relation between afferent and efferent nerve centers. Another proprioceptive center is Clarke's column, whose cells are structurally related to the efferent type; these cells send their axones to the cerebellum, and the significance of this connection will appear later. The nuclei gracilis and cuneatus constitute a more afferent type of center transmitting impulses to the thalamus, and the trace of efferent structure in their cells is possibly related to an indirect cerebellar connection.

Equilibrium is a special proprioceptive sense whose reactions are not local but general, and accordingly the entering vestibular root fibers form no direct connection with peripheral efferent centers. With the exception of the cerebellum the vestibular reception centers are composed of two kinds of cells, sharply separated neither topographically nor structurally; the larger cells are more numerous in the oral and lateral portions of the vestibular reception system and in structure resemble to a varying extent the cells of peripheral efferent centers. The smaller cells, situated more medially, are structurally also definitely efferent but in less degree. The larger strongly efferent cells connect directly with peripheral efferent centers, while the smaller less strongly efferent type apparently has a similar but more indirect connection; which type sends axones to the internal nuclei and cortex of the cerebellum is not known. Some vestibular root fibers end directly in the cerebellum, in both cortex and internal (efferent) nuclei. Through this direct connection as well as developmentally and functionally the cerebellum is closely related to the vestibular nuclei, and these are efferent. I have observed that the cells of all centers known to send axones to the cerebellum have an efferent structure, often not pronounced but yet definite. The cells of Clarke's column and of the vestibular nuclei have been mentioned; to these must be added the cells of the nuclei pontis and arcuate nuclei, those of the inferior olive and lateral reticular nucleus. In the cerebellum itself the Purkinje cells show efferent structure as do those of the internal nuclei, while the small cells of the cortex are devoid of such structure. I regard the cerebellum as a complex center decidedly more closely related to the efferent than to the afferent system.

The reception nuclei for general exteroceptive sense differ radically from those of the proprioceptive system, for the source of stimulus demands as a rule a less fixed and more general type of response. The majority of cells of such centers show no efferent structure, and their relation to the peripheral efferent centers is indirect. I have observed, however, cells of a definite efferent character both in the dorsal column of gray matter of the cord (in addition to those of Clarke's column) and also in the reception nuclei of the trigeminal nerve. The exteroceptive reception centers are complex, and in their local reactions the efferent impulse begins, at least partially, within these centers themselves.

Since the optic nerve is really a central tract its reception centers will not be considered. The cochlear nerve, serving the special exteroceptive sense of hearing, has central relations complex and imperfectly known. Some of its root fibers end in the dorsal and ventral cochlear nuclei, others in a group of cochlear reflex centers; some axones from the first group of centers end in the other cochlear reception centers. Many cells of the dorsal and ventral cochlear nuclei show efferent structure. The superior olive, trapezoid nucleus, and nucleus of the lateral fillet give origin to an extensive system of efferent paths and their cells are efferent in structure; although their connections are not accurately determined I regard these centers as probably purely efferent. Even in the inferior colliculi (secondary cochlear centers) I have observed a few cells of efferent type.

As yet I have not studied the visceral reception centers, but it is evident that those of the proprioceptive and exteroceptive groups are structurally closely related to the efferent system, that they may be peripheral efferent centers, pre-motor centers of different grades, or complex centers containing not only afferent but also efferent cells which vary as to number as well as to degree of efferent structure. I believe that caudal to the diencephalon sensory correlation is limited to the quadrigeminal plate, cerebellum and certain exteroceptive (and probably visceral) reception centers; none of these centers are purely sensory, while the cerebellum is largely efferent. In my opinion the extent of the efferent mechanism for local correlation has been greatly underestimated, and in this article I have shown its presence even within the primary reception centers.

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ON THE FORMATION OF ORGANIC COMPOUNDS FROM INORGANIC BY THE INFLUENCE OF LIGHT

The incentive for my first photochemical research, which was begun in 1911, was received through reading Schimper's work on the relation between nitrate reduction in green leaves and exposure to light. According to Schimper, leaves in the shade are always much richer in nitrates than leaves which have been exposed to direct sunlight. Little or nothing was known at that time in regard to the chemical aspect of nitrate reduction under the influence of light. It was not until later that I became acquainted with the important work of E. Laurent in which the formation of oxygen gas and potassium nitrite by the action of sunlight on sterilized potassium nitrate was described.

My photochemical experiments, carried out in Zürich, between 1911 and 1914, were concerned with the reduction of nitrates by light energy, either alone or in the presence of organic substances. At that time I did not employ iron in my experiments. My attention was first called to the importance of iron in nitrate reduction by some bacteriological experiments which I carried out during the war. In my work with cholera bacilli I found that their iron absorption and assimilation must be in direct relation with their power of reducing nitrates to nitrites and ammonia. On searching the literature for similar observations, I found that Schimper describes an experiment in which iron free (chlorotic) leaves were unable to reduce any nitrate at all, even on exposure to intense light.

It is very striking to observe the great rapidity with which cholera bacilli, taken from the intestine of a cholera victim immediately after death, reduce nitrates to nitrites in a peptone culture. In the case of cholera bacteria the reduction proceeds just as rapidly in the dark as it does in the light. The reduction of ninuc however, as I have shown, stands here rect relation to the oxygen respiration of bacteria and also to their iron content. nese observations led me to use iron in my purely chemical investigations on nitrate reduction.

As regards the chemistry of the process, the only relation known at that time was that ferrous hydroxide reduced potassium nitrate and in the process became oxidized to the ferric compound at the expense of the nitrate oxygen. From the physiological standpoint this stoichiometric process could have no importance, since only traces of iron are present in cells and these traces must become inactive at once because of their oxidation to the ferric compound.

I therefore had to search for a process in vitro which would show that the smallest traces of iron were capable of reducing large quantities of nitrate or nitrite and that this reduction failed entirely in the absence of iron.

In other words, I tried to find a chemical reduction process in which the iron acted as a catalyst. I succeeded in doing this when investigations with nitrites and sugar in carbonate solution were carried out. Grape sugar solutions do not reduce nitrates or nitrites, even when they are heated under pressure, but the smallest trace of an iron salt is sufficient to reduce a large amount of nitrite on warming with glucose in weakly alkaline solution. Under these conditions nitrates remain entirely unattacked.

The rôle which traces of iron play in this reduction process was entirely incomprehensible. Further experiments have thrown light on this chemical process, but a detailed description would be out of place here. The main points, however, should be discussed, *i. e.*, why nitrates remain unattacked and why nitrites are reduced extremely easily to ammonia, with the successive formation of the intermediate products KNO_2 and KNO.

The character of the alkali nitrites is determined by the auxiliary valencies of the nitrogen central atom:

$$\left(\begin{matrix}\mathrm{O}\\ \mathrm{N}\cdots\cdots\\ \mathrm{O}\end{matrix}\right)\mathrm{K}$$

while that of the alkali nitrates is determined by one oxygen atom, which I call the nitrate oxygen atom.

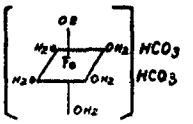
$$\left(\begin{matrix}\mathrm{O}\\ \mathrm{NO}\cdots\cdots\\ \mathrm{O}\end{matrix}\right)\mathrm{K}$$

This atom possesses residual affinity, but the nitrogen atom is completely masked. Nitrogen has a great affinity for iron and the reduction of alkali nitrites is induced by a primary linkage of the nitrite nitrogen to the iron nucleus. On the other hand, the affinity of iron for nitrate oxygen is not sufficiently great to bring about a primary addition and subsequent splitting off of an oxygen atom.

The question as to the manner in which nitrates were reduced to nitrites in biological processes was still unsolved. From my experiments with cholera bacteria and from Schimper's observation, it could be seen that oxygen appeared to be directly involved in the reduction of nitrates. In following up this idea experimentally I observed the surprising fact that oxygen in the presence of ferrous salts reduces nitrates instantaneously, even in the cold, with the *formation of nitrites*. This observation was fundamentally new. It was known that ferrous hydroxide or ferrous bicarbonate reduces alkali nitrates, but it was believed up to this time that the iron was oxidized at the expense of the nitrate oxygen. I have found that ferrous bicarbonate or hydroxide in the absence of oxygen even at the temperature of boiling water does not attack alkali nitrates to the slightest extent; the presence of oxygen, however, brings about immediate reduction to nitrite and there is a direct relation between the amount of oxygen dissolved in the water and the amount of nitrite formed.

This chemical process I should like to designate as the *origin of fertilization*. Two inorganic compounds of great energy content, such as ferrous bicarbonate and potassium nitrate, remain unchanged in an oxygen free aqueous solution. In contact with air, moist ferrous bicarbonate rapidly absorbs oxygen, either from the air or from water, and links a molecule in the inner sphere of the iron nucleus. This oxygen absorption I should like to compare with the fertilization of an ovum, since from the almost non-magnetic ferrous hydroxide or ferrous bicarbonate there is formed a peroxide compound which closely approaches metallic iron in its magnetic properties. This extremely energetic peroxide compound draws a molecule of potassium nitrate into the inner sphere of the iron nucleus and splits an oxygen atom from it with the formation of nitrite. There follows further reduction of the nitrite to the extremely reactive compound potassium nitrosyl, K(NO), which, at the same time, reacts with organic compounds present, especially aldehydes, with the formation of carbon and nitrogen containing compounds. Ferrous bicarbonate and oxygen in this case assume the rôle of light and reduce alkali nitrates to nitrosyl, which is a very reactive amphoteric intermediate product either of nitrate reduction or of ammonia oxidation. Ferrous bicarbonate peroxide, however, can give up the temporarily loosely linked oxygen molecule, which is thus somewhat activated, to oxidizable compounds which are present in the same solution, just as hæmoglobin absorbs oxygen and gives it back again for oxidation or dehydrogenation purposes.

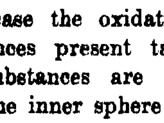
In this reaction, however, it is found that there is a selective action which depends upon the affinity of the compound to be oxidized to the central iron atom of the peroxide.



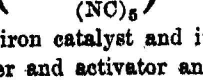
Compounds which are not primarily linked in the inner sphere by the iron atom are not oxidized. There is an analogy here to enzymatic reactions, which are characterized by their selective action brought about by residual affinity. In the reactions which we have described, residual affinity or auxiliary valence powers in the sense of Werner's theory play a decisive rôle. The selective character of this chemical reaction is probably based on them alone. Also, I believe that the reduction of nitrate to nitrite by light is introduced by the taking up of energy and the consequent activation of the auxiliary valence powers of the nitrate oxygen atom and of the oxygen of the water; the subsequent processes are reactions which can take place in the dark. In the case of the reduction of alkali nitrates with ferrous hydroxide peroxide, the energy is transmitted to the nitrate molecule by the strongly magnetic peroxide compound, with the splitting off of an oxygen molecule. The further reduction of alkali nitrite or nitrosyl to ammonia is doubtless brought about by nascent hydrogen formed by the decomposition of water molecules in the inner sphere through the action of the central iron atom in the peroxide compound.

From the preceding discussion it is apparent that many reactions are brought about by the fertilization of the iron molecule by molecular oxygen; there is, I believe, considerable evidence that the magnetic properties of the peroxide are in direct relation to its great chemical reactivity. It is worthy of note that complex ferric compounds are easily transformed into ferrous compounds by the influence of light or by hydrogen peroxide and thus are continually brought back into a reactive form which has the power of taking up oxygen. The well-known example is the reduction of potassium ferricyanide to ferrous compounds.

From neutral potassium ferrocyanide an alkaline compound is formed on exposure to sunlight for a period of a few seconds; on further illumination in the presence of air there results, besides free ferrous ions, an extremely reactive complex ferrous compound (potassium pentacyano-aquo-ferroate)



which links oxygen, nitric oxide or carbon monoxide to the central iron atom, just as hæmoglobin does. In air potassium pentacyano-aquo-ferroate absorbs and carries oxygen. Also in this case the oxidation of the oxidizable substances present takes place only when these substances are first linked coordinately in the inner sphere of the iron salt and, therefore, we are again dealing with a case of selective oxidation. Potassium pentacyano-peroxo-ferroate



$$\left(\mathrm{Fe}\begin{matrix}\mathrm{O_2}\\ \\ \mathrm{(NC)_5}\end{matrix}\right)\mathrm{K_3}$$

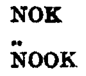
behaves like an iron catalyst and its action as an oxygen carrier and activator and as an activator of inorganic and organic compounds which show affinity to iron I should like to designate as the origin of respiration. The entrance of certain groups, in this case five cyanide groups, into the inner sphere of the iron nucleus, raises the power of the ferrous ion to absorb oxygen from the air. Especially interesting is the fact, observed by Miss Pfaltz and myself, that one reactive auxiliary valency of the iron nucleus can be made inactive by equivalent amounts of potassium cyanide, arsenic trioxide, carbon monoxide, or other blood poisons.

These purely chemical experiments harmonize with experiments of Jacques Loeb and of O. Warburg.

In 1906 Jacques Loeb expressed the view that the essential feature (or possibly one of the essential features) of the process of fertilization was the increase of the rate of oxidations in the egg and that this increase was caused by the membrane formation alone. These conclusions have been confirmed by the measurements of O. Warburg as well as those of Loeb and Wasteneys, both showing that the alteration or cytolysis of the cortical layer of the eggs is in some way connected with the increased rate of oxidations. O. Warburg has further shown that the oxidations in the sea urchin egg are due to a catalytic process in which iron acts as a catalyzer. The active iron ions of egg cells or of algæ can be made inactive by equivalent amounts of hydrocyanic acid, thereby causing respiration and nitrate assimilation to cease.

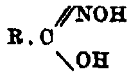
A neutral, unreactive aqueous solution of potassium ferrocyanide, which is quite stable in the dark, is extremely sensitive to light. The most important rays are those of long wave lengths, such as the bluish-yellow and red of daylight. These bring about the formation of an alkaline aquo base, as has been shown by L. W. Bass and myself. The reduction of alkali nitrates, on the other hand, is brought about only by light of short wave lengths, the ultra-violet and violet rays. In sunlight, during the summer, these rays are present in considerable quantities and the reduction of alkalinitrate to nitrite can be brought about in a short time if the oxygen which is split off is taken care of chemically, a process which may be brought about by addition of complex ferrous salts such as potassium ferrocyanide. The photochemical reaction $KNO_3 \rightarrow KNO_2 + O$ is thus accelerated by very small quantities of complex ferrous salts, a fact which was not known up to this time.

Let us now turn our attention to a compound which has not yet been isolated, but which is formed as a labile intermediate product in the reduction of nitrates with light energy or with ferrous hydroxide and oxygen. This compound is potassium nitrosyl K(NO), which was first described by A. Angeli in the so-called Angeli Salt



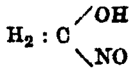
$$\begin{array}{c} NOK \\ \cdot\cdot \\ NOOK \end{array}$$

Potassium nitrosyl reacts extremely readily with aldehydes with the formation of hydroxamic acids



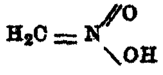
$$R.C\begin{array}{l} /\!\!/NOH \\ \diagdown OH \end{array}$$

In this reaction it forms an intermediate product, as I found with Coert, which is an addition product of potassium nitrosyl to the aldehyde group, entirely analogous in composition to the product formed when hydrocyanic acid adds to an aldehyde with the formation of a cyanhydrin. This labile addition product is nitroso-methyl alcohol, if formaldehyde and nitrosyl react together



$$H_2 : C\begin{array}{l} \diagup OH \\ \diagdown NO \end{array}$$

The stable product of the reaction, however, is formhydroxamic acid, which by itself is quite stable in the dark, but in light partially rearranges into aci-nitro methane.



$$H_2C = N\begin{array}{l} /\!\!/O \\ \diagdown OH \end{array}$$

By longer exposure to light various products result, among them methylamine. By color reactions it can be shown that the first product of the reduction of formhydroxamic acid by light energy is formaldoxime, which on further illumination suffers a partial Beckman rearrangement with the formation of formamide. Another part decomposes into hydrocyanic acid and water. Formaldoxime, which I found as one of the volatile constituents of cholera peptone culture, is doubtless a substance of physiological importance. With trivalent iron it forms very characteristic deep-red complex salts, which in light are transformed rapidly into colorless salts with bivalent iron.

Anhydrous formaldoxime polymerizes readily to a trimolecular form. In the dark in aqueous solution it is comparatively stable. In weakly alkaline solution or on exposure to light, however, there results a rearrangement of the atoms with the formation of an extremely labile intermediate product which links chemically to other formaldehyde molecules; compounds are thus formed which contain several carbon and nitrogen atoms linked together. In sunlight from formaldoxime and formaldehyde are formed cyclic nitrogen compounds which contain pyridine and pyrrol rings and which give the typical alkaloid reactions. Acetaldoxime behaves in an entirely analogous manner. In the spring of 1914 I exposed to sunlight on the roof of the Schatzalpsanatorium in Davos, in sealed glass flasks, a large quantity of acetaldoxime solution containing aqueous formaldehyde; the mixture formed a clear mobile liquid. One year later the flask contained, in place of the mobile liquid, a thick dark brown syrup which I did not have the opportunity to investigate further.

Nitromethane also behaves in a manner entirely similar to formaldoxime, since in weakly alkaline solution or under the influence of light it possesses the property of linking formaldehyde molecules chemically. In the case of nitromethane an intermediate product is known, namely, isonitrobutylglycerine, which Henry obtained from nitromethane and formaldehyde on the addition of traces of an alkali salt. I observed that the same compound results when nitromethane and formaldehyde in aqueous solution are exposed to the light from a mercury lamp. The formation of iso-nitrobutylglycerine proves again that compounds of the type of aci-nitromethane, formhydroxamic acid or aliphatic aldoximes react with formaldehyde readily to form compounds with a larger number of carbon atoms, a fact which is of particular importance in the formation of organic compounds from inorganic. The connection between the formation of iso-nitrobutyl glycerine and dihydroxyacetone oxime with compounds such as alanine, serine, etc., will only be indicated. The formation of compounds of this type from inorganic substances and light has not yet been realized experimentally. The fact should be mentioned that a short exposure of formhydroxamic acid in the presence of traces of iron to mercury light, or a long exposure to mercury light of a mixture of potassium nitrite, carbon monoxide gas and traces of ferric chloride gives a water solution containing amino nitrogen which forms dyestuffs with triketo-hydrindin hydrate, just as α-amino acids do. The completion of this work was interrupted by the war, and because of other circumstances can not be taken up at the present time. Recently E. C. C. Baly has repeated and extended my investigations and has confirmed all the results with regard to the formation of formhydroxamic acid, methylamine, alkaloids and α-amino acids.

By illumination of alkali nitrates with daylight in the presence of formaldehyde gases are formed which in their qualitative composition agree with the gases formed by soil bacteria. They are chiefly nitrous oxide, hydrogen, nitrogen, oxygen, carbon dioxide, carbon monoxide, traces of nitric oxide and hydrocyanic acid. The formation of formhydroxamic acid and of formaldoxime by the reduction of nitrates with oxygen in the presence of iron salts [$Fe(HCO_3)_2$] has been carried out by the writer experimentally. There is direct connection between the formation of these compounds and the formation of the aforementioned gases. The fact that soil bacteria (cholera bacilli also belong to this class) form the same gases which result from the reduction of nitrates in the presence of formaldehyde in sunlight, and the indication that formaldoxime is a product of bacterial activity and the photochemical reduction of nitrates with formaldehyde or with oxygen and iron lead to the conclusion that the chemical reduction processes in both cases are the same or are very similar. The bacteria, which do not need light, most probably use the energy of the iron peroxide in order to make nitrates available for building up proteins. It would be of the greatest interest to investigate whether nitrous oxide or nitrogen, with the help of complex iron salts and oxygen, can be linked in the inner sphere and thereby activated. Such experiments would lead to the still unsolved problems of the assimilation of free nitrogen by bacteria. I consider it to be possible that many soil bacteria and also green leaves utilise nitrous oxide for nitrogen nutrition and, just as they absorb carbon dioxide, they absorb this gas and assimilate it from the air, where, as I found, it is formed continuously by the action of sunlight on nitrogen and oxygen. Nitrous oxide resembles carbon dioxide in its physical properties; according to Langmuir they are isosteric and isoelectric molecules. Experiments in the dark and in light with green plants and with soil bacteria exposed to an atmosphere of nitrous oxide or nitrogen, in combination with purely chemical experiments on the reaction of nitrous oxide with iron salts, should make it possible to obtain a better knowledge of the problem of nitrogen assimilation.

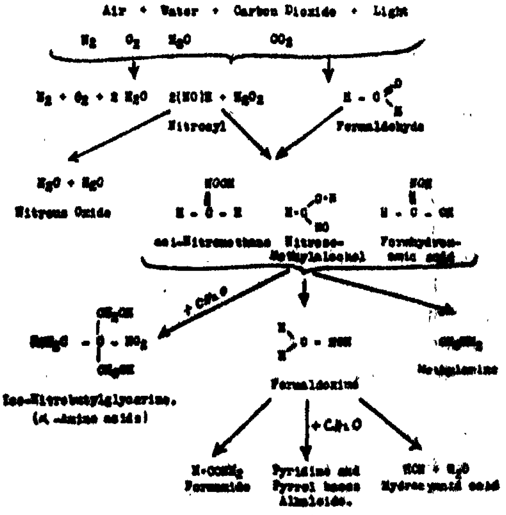
I shall now say just a few words on the reduction of carbon dioxide by light.

I believe that we are still far from the reduction, *in vitro*, of carbon dioxide to formaldehyde in large quantities by sunlight. The reduction of bicarbonates with mercury light gives only very small quantities of formaldehyde or sugar and it is questionable whether this process can be placed in parallel with the photochemical reduction of carbon dioxide in green plants.

It is quite different if the origin of the formation of organic compounds from inorganic is considered. Through exposure to intense ultra violet rays of very short wave length ($\alpha = 200\mu\mu$), such as one finds, for example, even at the altitude of the Monte Rosa peak, or by the influence of silent electric discharges, it has been shown that carbon dioxide is reduced to formaldehyde, and it is possible that this substance reacts with nitrous oxide formed from atmospheric nitrogen and oxygen to yield formhydroxamic acid. The synthesis of formhydroxamic acid from nitrous oxide and formaldehyde by exposure to sunlight has been carried out by the writer at the Mosso Institute on the Capanna Margheritta (4,600 m). There is as yet no basis for assuming that the formation of formaldehyde from carbon dioxide of the air and sunlight can be carried out at sea level without the aid of chlorophyll.

The formation of organic nitrogen containing substances from inorganic with the aid of light energy is, as you see, solved experimentally, and the methods which have been used lead to the assumption that organic substances found in nature may possibly be formed from air and light in the same or a similar manner. However, I am far from expressing the opinion that, in bacteria or in green plants, the synthesis of simple carbon and nitrogen containing compounds which I have outlined above is the correct one. E. C. C. Baly, who has repeated and extended my experiments, goes very far in his conclusions. For example, he writes the following sentence: "There is no doubt that formhydroxamic acid marks the first step in the phyto synthesis of the nitrogen compounds found in the plant." He proposes a table in which he begins with carbon dioxide and potassium nitrate and ends with proteins.

I believe that the further investigation of the synthesis of organic from inorganic compounds by light will lead to many interesting results, but the exact experimentation, with the isolation and analysis of the intermediate products, will require very great care on the part of the investigator. In sunlight at sea level most light reactions proceed extremely slowly and the secret of how green plants build up their protein from inorganic substances with the help of daylight will probably be unsolved for a long time.



OSKAR BAUDISCH

YALE UNIVERSITY

DINOSAURS AND COAL IN THE RED DEER COUNTRY, ALBERTA, CANADA[1]

IN the spring of 1884 I received instructions from the director of the Geological Survey of Canada to make a geological examination of the country between the Bow and Saskatchewan Rivers in what is now the province of Alberta. The area lay in a general way between north latitudes 51°, 30′ and 54°, and longitudes 110° and 115° west of Greenwich, embracing an area of about 45,000 square miles. This area covers the part of the valley of Red Deer River which has since proved to be the richest collecting ground for Dinosaurian bones in the world, and therefore a short account of their discovery may be of interest.

That western country was just beginning to be opened up. The Canadian Pacific Railway was built from Montreal to the Rocky Mountains, but it had not been connected through British Columbia to the shores of the Pacific. The townsite of Calgary had been decided on, but as yet the town consisted only of a few scattered houses, stores and stables in the vicinity of the railway station. A cable ferry, operated by current, made the crossing of the Bow River possible.

The Canadian government had adopted a regular system of survey for Manitoba and the North West Territory, consisting of meridian lines, run every fourth degree of longitude, between which base lines, nearly parallel to lines of latitude, were to be surveyed about twenty four miles apart. Between these base lines township boundaries were to be surveyed forming blocks six miles square, after which the included townships were to be subdivided into sections each a mile square. The surveys on this system had been begun, some of the base lines, as well as some of the township boundaries had been run, but no comprehensive maps had been prepared, and the maps with which I was furnished were based on a map made in 1813 by David Thompson, the old astronomer, surveyor and fur-trading partner in the North-West Company, with additions by Palliser and Hector in 1857 to 1860. It was therefore necessary for me while making geological investigations to do my own geographical surveys.

On the 12th of May I left Ottawa and on the 24th arrived at Calgary and proceeded to secure an outfit, the main items of which consisted of a wagon and buckboard, four or five horses, a canvas boat, tents, blankets and such like equipment. Rifles and shotguns must not be forgotten, for it was necessary for us to augment our food supply from the wild game of the country. In fact the expeditions of Dr. Dawson, Mr. McConnell and myself were at the time sometimes facetiously referred to in Ottawa as *Geological Cavalry*. My surveying instruments consisted of prismatic compass, odometer, to be attached to the wheel of the buckboard, tape line, watch, aneroid, sextant and artificial horizon.

To drive the team, pitch camp, do the cooking, etc., three men were engaged, two of them being halfbreeds and brothers named Mathew and Joseph Cook, and the other named Fitzpatrick, who had been in the American army in the west. Later in the year Mulligan and Gough were engaged to take the places of the Cooks.

In 1883, I had acted as assistant to Dr. G. M. Dawson on his geological survey of the Rocky Mountains and their eastern foot-hills, between the 49th parallel of latitude and the Bow River, but this was my first experience as the independent head of a geological survey party, and as we crossed the ferry on May 30th and drove out over the apparently limitless grass-covered plains, I could realize something of the feeling of the young mariner who wishes to sail his ship within sight of shore rather than strike out across the boundless ocean. At that time the whole country was a vast solitude, and one would travel for weeks at a time without seeing any white man, or in fact any human being.

After four days driving northward we arrived at the Red Deer River about eight miles, measured in a straight line, above the mouth of Paskapoo or Blind Man River. Red Deer River itself runs through the middle of the area which we were to explore, and consequently I thought it advisable to see it first in order to obtain a general impression of the work that was before me. Here sending two men with the horses, buckboard and wagon to meet us at the mouth of Rosebud Creek, 120 miles farther down the stream, Mathew Cook and I took the canvas canoe and started down the river itself, keeping a rapid survey as we went. At the mouth of Blind Man River the brown sandstones of what I afterwards called the Pascapoo formation at the base of the Tertiary are very well exposed, while farther down the stream the white and light gray clayey sandstones, with coal seams, of what I afterwards called the Edmonton formation, at the top of the Cretaceous, compose the banks.

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[1] Read before Section of Geology of the American Association for the Advancement of Science on December 27, 1922.

On June 9, after having spent a long and hot summer morning on the river, estimating the thickness of the various beds in the upper part of the Edmonton series, and endeavoring to correlate them one with another in the succession of cliffs as we passed down the stream, and their relation to two coal seams that could be detected now and then, Mathew Cook and I stopped for lunch on the east bank of the river under the shade of some cottonwoods, just south of north latitude 52°, in what is now section 11, township 35, range 21, west of the fourth Meridian. After lunch I walked eastward for three-quarters of a mile across the valley and climbed its eastern side. At an elevation of about 200 feet above the river, scattered among a large number of nodules and irregular masses of brown ironstone which formed conspicuous objects on the hillsides of white sandstone, I found and made a small collection of Dinosaurian bones, being the first of such bones found or collected in the valley of Red Deer River.

Next day we stopped for lunch beside the river where the steep sandstone banks of the valley are 300 feet high. Here Dinosaurian bones were again found to be abundant, and it was here that , five years later, Mr. T. C. Weston, the collector of the Geological Survey of Canada, found the second skull of *Dryptosaurus incrassatus.*

From there downwards similar bones were noticed in a number of places, being especially abundant on the steep hillsides east of the river, a short distance above the mouth of Knee Hills Creek.

On June 12, while passing the site of the present town of Drumheller, where now 1,000,000 tons of coal are annually mined; I landed on the north side of the river, and examined and measured the seams outcropping there, and took a sample from the outcrop of the thickest seam. As far as I know that was the first time that these coal seams had been examined. In all probability coal is now the most important product of that district to the people living on the plains, but nevertheless the Red Deer valley is better known throughout the world for its Dinosaurs than for its coal.

After completing our canoe trip on the Red Deer River, we took the horses and drove in a wide circle, first eastward and then northward and northwestward to Edmonton, and then southward back to Calgary to refit and replenish our supplies. One evening, during the course of this journey we rode up to within a hundred yards of a herd of about twenty buffalo, probably one of the last herds of wild buffalo to come north into Canadian territory.

On July 22, we again left Calgary, and this time we first went westward up along the north side of Bow River into the foot-hills of the Rockies, thence we turned northeastward along the edge of the wooded country to the headwaters of Rosebud River, and thence we followed the banks of that river to its mouth in the Red Deer Valley, five miles below the site of the present town of Drumheller. On August 8, one of the last days of this trip, the axle of the wagon broke, and we were obliged to replace it by one hewn out of a green spruce tree. This served our purpose for a while, but we were always faced with the uncertainty of how long it would last, and the certainty that it would not last very long.

On August 11 we turned northward from Rosebud creek on an old Indian or halfbreed trail across the prairie. Following this for twelve miles we descended into the deep gorge-like valley of Knee Hills Creek, which we reached two and a half miles above its mouth, and a short distance below the mouth of Horseshoe Canyon, which joins the valley from the south. It was probably a mile or two below the station or siding of Gatine on the Drumheller branch of the Canadian Pacific Railway. The creek is about twenty-five feet wide and eighteen inches deep. We camped that night on a beautiful green sheltered flat with wood, water and grass in abundance to provide for the needs of ourselves and our horses. At and near the bottom of the bank were fine large poplar trees, with a few spruce, while Service or Saskatoon berries and cherries were growing in great abundance. The banks of the valley were rocky, delighting the heart of the geologist who was sated with the undulating grassy plains, but it was too late to examine them that night.

The next day, however, I walked up the bank close to camp, and at an elevation of between forty and eighty feet above the creek found a number of Dinosaurian bones in an excellent state of preservation, though very brittle. Most of them were heavy and massive, such as those of the limbs, etc., but among these was a large and fairly perfect head of Laelaps (Dryptosaurus) incrassatus, a gigantic carnivore. We spent the afternoon excavating these bones from the rock, but unfortunately we had no appliances but axes and small geological hammers. We worked with all the care that the tools and the time at our disposal would allow, but in spite of all we could do some of the bones, teeth, etc., were broken. Then after we had managed to get them out of the rock, we had no proper means of packing them, and no boxes but the wagon box to put them in. However, we got together the skull and some of the best of the leg and other bones and then found that we had a heavier load than we were able to carry with us. We were therefore obliged to leave a small pile of bones at the bottom of the bank just north of the creek, on the chance that we might be able to pick them up at a later date, which fortunately we were able to do two months afterwards when returning from another expedition. After completing this work, and packing up our precious collection as well as we could, we started in a cold drizzling rain on our way to Calgary. First we were obliged to climb up to the top of the bank of the valley and it was so steep that with three horses we were not able to haul up much more than the empty wagon, while the fossil bones that we were able to take with us were packed up to the top of the bank on the backs of the horses.

Our journey to Calgary took us a week, for we were obliged to drive slowly and carefully, both on account of having the poor spruce axle in the wagon and because we were anxious not to jar the brittle Dinosaurian bones any more than necessary, though the riding could not be made very easy, since our course for the most of the way was over the rough unbroken prairie, and not on a road or trail. Our regular geological survey of the country passed through was also carried on as usual, for an exploring geologist rarely ever has the opportunity of seeing a particular place or tract of country twice. This survey included an examination of the banks of the valley of Knee Hills Creek from our Dinosaur camp upwards, for they furnish an excellent series of sections of the Edmonton and lower Pascapoo rocks. While making this examination of the valley, and when at a point about five miles above Dinosaur camp, we found one end of a large limb bone, the piece preserved being twenty-six inches long, four and a quarter inches across the middle of the shaft, and eight and one half inches across the end or head.

At Calgary the bones were packed in boxes and shipped to the director of the Geological Survey in Ottawa, whence they were sent to Professor Cope in Philadelphia for examination and description. The skull, along with another similar one obtained by Mr. T. C. Weston in 1889, who was sent out on my suggestion and solicitation by the director of the Geological Survey of Canada, for the especial purpose of collecting Dinosaurian bones in the same vicinity, was described by Professor Cope, and afterwards with illustrations by Mr. L. M. Lambe, but the other bones were probably not sufficiently perfect for identification, and as far as I know have never been described.

After the collection was shipped, I started back with the little party of men and horses to continue the exploration of the district allotted to me.

J. B. Tyrrell

EXPLOSIVE ERUPTIONS OF KILAUEA

Owing to the spectacular character of the fire fountains of Kilauea, but little attention seems to have been given to the evidences of explosive eruptions of the genuine Vesuvian type, and this volcano has become known for quiet, well-ordered activity. Some recent field studies of the writer indicate that there are evidences of four explosive eruptions, probably separated by considerable time intervals, two of the centers of activity being in the northern and two in the southern sections of the great crater. The fire pit of Halemaumau seems to serve as a safety valve for the escape of the gases held in solution by the molten lava, but when this pit freezes over and these gases accumulate, sufficient pressure beneath the crust is violently shattered and the more or less comminuted fragments and effervescing lava are hurled into the atmosphere. The coarser blocks and bombs settle first and for the most part nearer the vent, while the finer fragments making up the gravel, lapilli, sand and dust are deposited in succession, giving rise to a more or less well-defined stratification as viewed in vertical section. If the wind is active at the time of the eruption, the lighter and finer materials will be drifted to considerable distances and each stratum will show the heavier and coarser material toward the vent, passing radially into the lighter and finer deposits, thinning more or less gradually and finally becoming indistinguishable from the subjacent deposits.

In addition to the four above mentioned explosive eruptions there is evidence of a fifth of very minor character supplied by witnesses who furnished the earliest written descriptions of this volcano (Ellis, Loomis, Stewart, 1823-1825). The activity seems to have culminated in 1825 about the time of the visit of Lord Byron, when "red-hot stones, cinders and ashes were also propelled to a great height with immense violence." The records since this date indicate no such explosive activity, but a welling up of the molten lava, accompanied often by much vigorous fountaining and ending in an overflow over the floor of the great crater (1844, 1849, 1868, 1918 and 1921), an escape into adjacent minor craters (1832, 1922), an outbreak through fissures in the sides of the Kilauean mass (1840, 1868) above sea level or as a submarine flow as apparently occurred in 1849 and 1884. Only once in the entire history of the volcano has it been known to overflow the rim of its crater and this to only a trifling extent as recently as March, 1921.

The first of the series of explosive eruptions of which we have any present evidence took place so long ago that nearly 500 feet of successive lava flows overlie the stratum of fragmental matter ejected at the time. Judging from the present slow rate of pericentric outpourings and the small average thickness of these overlying layers, this would call for a great period of time as measured in years. But conditions may be readily imagined under which this time would be greatly reduced. This eruption began apparently with the ejection of dust and sand and was followed by lapilli, some bombs and large and small blocks. No trace was found of the dumb-bell or Indian-club droplets or of that peculiarly light form of pumice known locally as "limu," or the "thread lace scoria" of Dana. This stratum is to be seen only in the northwest quadrant of the crater wall, and in the last few years much of it has been covered by recent outpourings from Halemaumau. Between this first of which we have record and the above mentioned fifth, which left nothing of a recognizable nature, we find evidence of three other violent eruptions.

The number four of the series was the locally well-known eruption of 1789-90 which annihilated a division of Keoua's army bivouacing in the vicinity. Native eye witnesses reported that the eruption was preceded by violent earthquake shocks, terrific thunder and lightning, when a dense cloud of darkness rose from the crater and enveloped the entire region. Showers of sand and cinders soon began to fall and these were followed by coarser fragments, some of which were glowing and occasionally bursting with loud report. The deposit from this eruption was concentrated mainly about the southeastern quadrant of the crater and appears to have not come from Halemaumau, but from somewhat nearer the center of the main crater. The maximum thickness observed was about 12 feet, and the deposit contains little dust and sand, consisting in the main of unconsolidated material which would ordinarily pass as gravel. The direction of the wind seems to have been mainly from the northwest, finally shifting around to the northeast, and carrying south-westward quantities of limu. Bombs ranging from the size of unhulled walnuts to the size of a head are found rather abundantly, and the eruption ended apparently with a terrific shower of lava blocks which fell upon a crusted surface which to this day retains the impact basins resulting from their fall.

Lying unconformably beneath this relatively recent material and separated from it by erosion surfaces and in some cases thin lava flows, we find the deposits of two apparently separate eruptions which we designate as second and third in the series. They were both characterized by the ejection of quantities of volcanic ash, concentrated about the northeast and southeast quadrants of the crater respectively and extending some three or four miles beyond the rim so far as appreciable deposits are concerned. The older of the two started with a small amount of fine ash and then with quantities of the thread-lace scoria of the most perfect type and a peculiar type of dumb-bell and Indian-club droplets; so far as known formed only at this time, probably because of some peculiar consistency of the magma. This deposit is that seen about the Volcano House and the roadway leading east and west. In the crater itself the deposit attains a thickness of twenty-five to thirty feet. Wherever observed the basal layer was found to carry more or less of the perfect type of thread-lace scoria, quite readily distinguished under the magnifier from that ejected in 1789, as well as the recent samples collected by Jaggar from Mauna Loa. This eruption closed as did that of 1789 with the discharge of many volcanic blocks, large and small, directed mainly to the northwest for a distance of two to three miles from the rim. Superficial field observations indicate that these blocks have been longer exposed to the weather than have those of 1789, and that they bear a relationship to the dike material found in the adjacent crater wall.

The deposits of the third eruption of the series are for the most part fine and very perfectly stratified. Bombs and blocks are rarely seen and no limu or droplets characterize the sections. The eruption began apparently with the ejection of a black sand, which fell upon a weathered and rusted surface of pahoehoe. This was followed by clouds of fine dust, attaining a maximum thickness about the southeastern quadrant of the crater of some forty-five feet. Along the extended minor, or east-west axis of the crater, these deposits overlap those of the second eruption, if we are justified in attaching correlation value to the true thread-lace scoria. However, in the crater they are much more firmly indurated than the latter, through the action of steam and other gases and hence have the appearance of greater age.

During certain stages of this eruption, as well as that of the second and fourth in our series, rain drops falling through the hot, dust-laden atmosphere became completely charged with the fine dust, arranged in concentric shells and slightly cemented and dropped into the soft ash layer beneath without undergoing appreciable distortion. Some of these are still firm enough to be rolled along and segregated like pebbles by temporary rills. Similar bodies fell abundantly in the vicinity of Naples on the morning of April 8, 1906, Vesuvius being then in eruption (Bassani and Galdieri). Specimens from Kilauea were photographed by Perret in 1914 and referred to by Friedlander under the term "pisolites." Is there any serious objection to calling them fossil rain drops? During the closing stages of the second eruption these pellets grew to the size of one's thumb, as in the case of ordinary hail stones, as suggested by Lane, and were slightly flattened by their fall or possibly manner of formation. To the west and northwest of the main crater, beyond the limits of the coarser debris, these remarkably preserved structures may be collected by the bushel.

W. H. SHERZER

MICHIGAN STATE NORMAL COLLEGE,
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SCIENTIFIC EVENTS

THE PI MU EPSILON MATHEMATICAL FRATERNITY

IN these days of the extreme emphasis on and acclaim accorded to athletic prowess, it was but natural that scholars in their different fields should establish honors and emoluments for the recognition of mature and successful scholars and for the encouragement of younger aspiring scholars that should challenge, encourage and reward their intellectual prowess. Among such means of honor and encouragement are honorary national fraternities in special fields of scholastic endeavor. The basis of membership in these fraternities is scholarship.

It is not surprising therefore that such a national fraternity has been established for mathematicians. This fraternity had its birth at Syracuse University. The Mathematical Club of Syracuse University was organized in 1903. After it had had ten years of successful existence, it was entirely reorganized and became the first chapter of the Pi Mu Epsilon Mathematical Fraternity, which was founded at Syracuse University and incorporated on the twenty-fifth of May, 1914, at Albany, under the laws of the state of New York. "Pi Mu Epsilon is an academic fraternity in institutions of university grade," says the constitution. Its primary aim is the advancement of mathematics and scholarship. While its members are elected entirely on the basis of scholarship in mathematics and other subjects, it is not merely an honorary fraternity in that election to membership is all there is to it. It is a living, active, working fraternity of scholars, in which the members are actively engaged in study and research in the preparation of papers in the field of mathematical science to be presented at its regular meetings.

The following classes are eligible to membership in Pi Mu Epsilon: Any one whose work in the mathematical sciences is distinguished; members of the mathematical faculty; major and minor graduate students of mathematics; any former graduate whose work in mathematics was or is distinguished; major and minor undergraduate students of mathematics who attain the standard of scholarship set by the fraternity for eligibility to membership of such undergraduates.

One of the features of the fraternity's activity is the preparation on the part of each chapter of a circular letter to be sent to all the chapters at least once a year, and containing items of interest concerning its work and programs and list of officers, in order that, according to the constitution, "the chapters may realize the benefits of that fraternal interaction and stimulus, which was one of the reasons for founding the fraternity."

The fraternity now has six chapters, in the order of their installation, at Syracuse University, Ohio State University, University of Pennsylvania, University of Missouri, University of Alabama, Iowa State College of Agriculture and Mechanic Arts.

The national officers of the fraternity are: *Director general,* Professor E. D. Roe, Jr., Syracuse University; *vice-director general,* Mr. William V. Houston, Ohio State University; *secretary general,* Professor Warren G. Bullard, Syracuse University; *treasurer general,* Miss Louisa S. Lotz, University of Pennsylvania; *librarian general,* Miss Mabel G. Kessler, University of Pennsylvania.

E. D. Roe, Jr.

THE ARNOLD ARBORETUM OF THE HARVARD UNIVERSITY

The committee appointed by the Board of Overseers of Harvard College to visit the Arnold Arboretum has issued the following statement:

> The arboretum was established fifty years ago as the university's museum to increase the knowledge of trees and shrubs, of which it has now the largest living collection in America, supplemented by a great herbarium and library, and is everywhere recognized as the most important institution of its kind in the world, and also as one of the most beautiful of all public gardens. For forty years it has been the most active and successful of the agencies for the discovery and study of new trees and shrubs; and to-day it is a great national institution of world-wide usefulness and reputation, to whose initiative and example the parks and gardens of America owe much of their beauty.
>
> The arboretum has outgrown its endowment, which produces only $40,000 a year, and to meet the deficits of income the director has been obliged for a long time personally to raise every year from forty to fifty thousand dollars, which have been given usually by not over one hundred and twenty persons chiefly living in Greater Boston. A still larger income will be required if the arboretum is to broaden its influence and maintain its position. Professor Charles S. Sargent has been director of the arboretum for fifty years, and it is time that he should be relieved of this burden of money-raising.
>
> A national institution is entitled to national support. Will you not contribute $10 or such larger sum as you feel able to give for the work of the arboretum? Every contributor will receive in return the arboretum's *Bulletins of Popular Information,* containing information about all new and interesting plants, the illustrated guide to the arboretum, if desired, and any assistance and advice about his own plants that can be furnished by correspondence.

The visiting committee consists of Roger Wolcott, William C. Endicott, Theodore A. Havemeyer, Mrs. L. A. Frothingham, Charles L. Hutchinson, Richard T. Crane, Jr., Henry F. du Pont, Galen L. Stone, Henry S. Hunnewell, Albert C. Burrage, John E. Thayer, Mrs. Harold I. Pratt and Henry H. Richardson.

THE ELECTRON IN CHEMISTRY

Sir Joseph Thomson gave a course of five lectures on "The electron in chemistry" before the Franklin Institute, Philadelphia, during the week of April 9. The topics treated were as follows:

Lecture 1: The atomic theory had little effect on the progress of chemistry as long as nothing was known about the structure of the atom. The discovery of the electron showed that atoms have a structure and gave a clue to its character. The arrangement of the electrons in the atom. Number of electrons in the atom. Electronic isomers. Active nitrogen. Instability of configuration when electrons are too crowded. Eight the maximum number of electrons which can be on the outer layer of an uncharged atom. This result involves a periodicity in the properties of the atoms of the different elements, such as is expressed by Mendeleef. Periodic law. Valency. The size of atoms. Specific inductive capacity. Work required to abstract an electron from an atom. Methods for testing the configuration of electrons in an atom.

Lecture 2: The combination of atoms to form molecules. Physical interpretation of chemical "bonds." Double bonds. Union of two similar atoms to form a molecule. Union of two or more dissimilar atoms. "Positive and negative" valencies. Arrangement of electrons in octets. Comparison with the results of the old valency rules. Stability of systems of octets. Instability chains in octets in general. Stability of CH_2 chains. Polar molecules. Importance of these in chemical reactions. Problem of the water molecule. Arrangement of the electrons in chlorides, chlorates, perchlorates, carbonates, sulphates, sulphites, nitrates, nitrites. Connection between the arrangement of the electrons and the acidic or basic properties of the compound.

Lecture 3: Mechanism of chemical combination. Active molecules. Their occurrence in such reactions as the combination of hydrogen with chlorine or of oxygen with hydrogen. Afford a physical basis for Thiele's theory of partial valencies. "Molecular compounds." "Residual affinity." Double salts. Electron theory gives a physical basis for Werner's coordination theory. Mechanism of electrolytic dissociation. Structure of the ions in liquids. Catalytic action. Variable valency and homologous elements.

Lecture 4: Connection between variable valency and the magnetic properties of the elements. Magnetism of chemical compounds. Magnetism of oxygen. Dia-magnetism affords a method of checking the configuration of the atom and the migration of the electrons in chemical combination. The electron theory of solids. General considerations. Calculation of the energy of a solid.

Lecture 5: The calculation of the electron theory of the compressibility of the elements in a solid state. Critical periods of vibration for solids. Latent heat of evaporation. Compressibility. and specific inductive capacity of salts. The structure of metals, salts and insulators. Electrical conductivity of metals.

PRESENTATION OF THE JOHN SCOTT MEDAL AWARDS

The City of Philadelphia, through its board of directors of city trusts, made the annual presentation of the John Scott Medal Awards at a special meeting of the American Philosophical Society on the evening of April 10. The awards were as follows:

To Sir Joseph Thomson, O.M., F.R.S., master of Trinity College, Cambridge, for his researches on the physics of the electron.

To Francis William Aston, D.Sc., F.R.S., of Trinity College, Cambridge, for his development of the mass-spectrograph and his studies of isotopes; to be received by his Excellency the British Ambassador or his representative, H. G. Chilton.

To C. Eijkman, M.D., of the University of Utrecht, for his researches on dietary diseases; to be received by His Excellency the Minister from the Netherlands.

To Arthur Louis Day, Ph.D., Sc.D., director of the Geophysical Laboratory of the Carnegie Institution of Washington, for his researches on optical glass.

Dr. Hobart A. Hare represented the board. Responses were made by Sir Joseph Thomson, by Mr. H. C. Chilton on behalf of the British Ambassador for Professor Aston, by the Minister from the Netherlands for Professor Eijkman, and by Dr. Day.

The awards are made annually by the City of Philadelphia from the income of the John Scott fund upon recommendation of an advisory committee of five, consisting of representatives from the National Academy of Science, The American Philosophical Society and the University of Pennsylvania. The former body is represented by William B. Scott, of Princeton; Theobald Smith, of Princeton, and Henry H. Donaldson, of the Wistar Institute, Philadelphia; the American Philosophical Society by Samuel M. Vauclain, of Philadelphia, and the University of Pennsylvania by Arthur W. Goodspeed, of Philadelphia.

SCIENTIFIC NOTES AND NEWS

GEORGE LINCOLN GOODALE, professor of botany at Harvard University from 1873 until his retirement as professor emeritus in 1909, president of the American Association for the Advancement of Science, died on April 12, in his eighty-fourth year.

ALICE CUNNINGHAM FLETCHER, assistant ethnologist of the Peabody Museum, Harvard University since 1882 and the holder of the Thaw fellowship of the museum since 1891, has died, aged seventy-seven years.

THE University of Pennsylvania, at a special convocation on April 11, conferred the honorary degree of Doctor of Science on Sir Joseph Thomson, master of Trinity College. Sir Joseph, after concluding his lectures before the Franklin Institute, returned to Engand on April 14 on the *Homeric*.

IN the Paris Academy of Sciences M. Louis Gentil, professor of physical geography at the Sorbonne, has been elected to succeed the late M. Favé. M. Gabriel Bertrand, professor of biological chemistry at the Sorbonne and the Pasteur Institute, has been elected to succeed the late Georges Lemoine.

IT is stated in *Nature* that the Mueller medal and fund have been awarded to Mr. J. H. Maiden, government botanist of New South Wales and director of the Botanic Gardens, Sydney, in recognition of his botanical work. The medal was founded in memory of the late Baron von Mueller, government botanist of Victoria, and is awarded at each meeting of the Australasian Association for the Advancement of Science which this year met at Wellington, New Zealand.

FOUNDERS' Medal of the Royal Geographical Society has been awarded to Knud Rasmussen, the Danish explorer, for his explorations and research in the Arctic in the last twenty-five years.

THE University of Manchester will confer its honorary doctorate of science on Professor Niels Bohr, Copenhagen; Professor F. G. Hopkins, Cambridge; and Mr. W. B. Worthington, president of the Institution of Civil Engineers, 1921-1922.

DR. W. A. MURRILL, supervisor of public instruction at the New York Botanical Garden, with which he has been connected for 20 years, has been awarded a gold medal by the Holland Society of New York, for his distinguished service in the science of mycology. The presentation took place at the meeting of the society in the Hotel Astor on April 6, and was followed by an address by Dr. Murrill on "Fungi and their relation to forestry."

AT the annual meeting of the Chemical Society of Great Britain Professor W. P. Wynne, Firth professor of chemistry in the University of Sheffield and dean of the faculty of pure science, was elected president for the ensuing two years to succeed Sir James Walker, who addressed the meeting on "Symbols and formulae." There were present Professor Henri Le Chatelier, representing la Société Chemique de France, and M. Paul Kestner, representing la Société de Chimie Industrielle.

A NUMBER of chemists of the Northeastern Section of the American Chemical Society entertained at dinner on April 7, at the University Club, Boston, J. C. Irvine, principal and vice-chancellor, University of St. Andrews; F. G. Donnan, professor of physical chemistry, University College, London; Th'e Svedberg, professor of physical chemistry, University of Upssala, and Professor E. C. Franklin, of Stanford University, president of the American Chemical Society.

Dr. Alice Hamilton, assistant professor of industrial medicine at Harvard University Medical School, Boston, was the principal speaker at the annual meeting and banquet of the Chicago Tuberculosis Institute held in Chicago on March 26.

Grants from the Gordon Wigan fund of the University of Cambridge have been made to Professor Punnett for plant-breeding experiments, to the Museum of Zoology for cases, to Professor Gardiner for a centrifuge and incubator, to Mr. Harker for sections of rocks, and to Professor Seward for sections of fossil plants.

The British Secretary for Mines has appointed Sir Frederick L. Nathan, Mr. J. D. Morgan, Mr. W. Rintoul and Professor R. V. Wheeler to be a sub-committee of the Explosives in Mines Research Committee to carry out investigations on the means employed for firing explosives.

Colonel P. Kozloff, the Russian explorer of Inner Asia and holder of the Founder's Medal of the Royal Geographical Society, is about to start on a three years' expedition to Tibet and adjacent regions.

Mr. G. H. Wilkins, the naturalist of the *Quest*, arrived in Melbourne in the middle of March to lead the British Museum exploration expedition which is to visit Northeast Australia and then New Guinea to study the flora and fauna.

Mr. Neil M. Judd, curator of American archeology in the U. S. National Museum, will leave Washington May 1 to resume direction of the National Geographic Society's expedition for the exploration of Pueblo Bonito, one of the largest and best preserved prehistoric ruins in the southwestern United States. This exploration is now in its third year; it is expected that the investigations will have been concluded late in 1925. Mr. Judd's staff this year will include assistants, and, as heretofore, experts will participate in the annual symposium to be called at the close of the excavating season. A force of twenty Indians, both Navaho and Zuñi, will be employed in the operations.

Dr. Ellsworth Huntington, president of the Association of American Geographers and research associate in geography at Yale, has been granted a leave of absence from the university for the first term next year. He is leaving New Haven on May 22 for Japan and China, and will later go to northern Australia, where he will study tropical conditions. He will attend the Pan-Pacific Scientific Congress which will be held in Sydney and Melbourne, beginning August 13, and will then carry on his investigations in the deserts of Australia. Before returning to the United States at the end of the year for the meetings of the Association of American Geographers, Dr. Huntington will visit the East Indies and will study the ruins in Indo-China, comparing them with those in Guatemala.

Dean Henry P. Talbot of the Massachusetts Institute of Technology has been granted a leave of absence until next September. During his leave he expects to visit a number of colleges including Princeton, University of Pennsylvania, Johns Hopkins, University of Virginia, Tulane University, Georgia School of Technology, Rice Institute, California Institute of Technology, University of California, Leland Stanford, University of Oregon, Reed College and University of Washington. Mrs. Talbot will accompany him. During his absence Harold E. Lobdell, assistant dean, will act in his stead.

Following the meeting of the American Chemical Society at New Haven Professor G. Bruni, of the University of Milan, lectured on April 9 at Columbia University on "Theoretical and practical rubber chemistry"; on April 12, before the Pittsburgh Section of the American Chemical Society, on "Italy's part in chemical scientific development," and on April 13, at Ohio State University on the same subject.

Lafayette B. Mendel, professor of physiological chemistry at Yale, left New Haven on April 6 for the Pacific Coast. As has already been reported in Science, he will deliver lectures at the University of California on the Hitchcock Foundation, his general subject being "Nutrition", and will also lecture at other places. He has leave of absence from Yale for the balance of the college year.

Dr. W. D. Matthew, F. R. S., curator of the department of paleontology, American Museum of Natural History, delivered an address on March 10 at Toronto to the Royal Canadian Institute on the subject, "Ancestry of the horse and other geological records of evolution."

Dr. Milton J. Rosenau, professor of preventive medicine and hygiene at Harvard University, gave a lecture on March 12 before the Wisconsin Branch of the Society of American Bacteriologists on "Food poisoning." This was followed by a dinner at which Dr. Rosenau spoke about his experiences in the famine district of Russia.

Dr. A. J. Dempster lectured at the University of Iowa on March twenty-sixth on the subjects "Light emission in canal rays" and "Isotopes.".

Dr. Louis A. Bauer, director of the Department of Terrestrial Magnetism, gave on March 31 an illustrated talk at the General Electric Company, Schenectady, N. Y., on "The present status of our knowledge regarding the constitution and causes of the earth's magnetic field." He also gave a talk on "The earth's magnetism" at the General Electric Company, West Lynn, Massachusetts, on March 30.

At the February meeting of the Research Club of the University of Vermont, Dr. M. B. Cummings, of the department of horticulture, addressed the club on "Sterility in plants."

Professor Walter B. Pillsbury, who has leave of absence as head of the department of psychology in the University of Michigan, has been lecturing at Montpelier, France, where he delivers a series of eighteen lectures. Professor Pillsbury expects to lecture in Paris the latter part of May. From Paris he will go to England. He will probably return to the university in time for the opening of the first semester next fall.

Dr. Sven Hedin lectured on "The great desert of Asia" at Clark University on March 26. He has also been lecturing in Boston and other New England cities.

T. Alexander Barns, explorer and author of "The Wonderland of the Eastern Congo," has arrived in the United States to lecture on his experiences in the Congo and on the opportunities offered by that country. His first lecture was before the National Geographic Society in Washington.

Dr. A. H. Compton, head of the department of physics, Washington University, St. Louis, lectured before the graduate students in physics at the University of Iowa on April 4 and 5 on "Some problems in the study of X-rays" and "A quantum theory of X-ray scattering".

Dr. David Marine, of the Montefiore Hospital, New York city, will deliver the eighth Mellon lecture entitled "The importance of our knowledge of thyroid physiology in the control of thyroid diseases", before an open meeting of the Society for Biological Research of the Medical School, University of Pittsburgh, on the evening of May 10, 1923.

Dr. John Merle Coulter, of the University of Chicago, was the guest of the Scientific Club of the College of Wooster on April 4. He gave a public lecture under the auspices of the club on "Evolution and religion". He also addressed the students of the botany department, giving them an interesting account of his experiences as botanist of the Hayden expedition in 1872, when it explored and mapped the geyser region of the Yellowstone. He also appeared before the staff of the Ohio Agricultural Experiment Station, speaking on "The botanical opportunity".

The following public lectures are being given this spring at the Brooklyn Botanic Garden: April 13, "Trees in nature and art," Dr. A. F. Blakeslee, resident investigator in plant genetics, Station for Experimental Evolution, Cold Spring Harbor, L. I. April 20, "Forestry in the United States," Professor Henry Solon Graves, dean, School of Forestry, Yale University. April 27, "What's new in the garden," Mr. Edward I. Farrington, editor of *Horticulture*, Boston, Mass.

The death is announced on March 18 of Sir William Thorburn, emeritus professor of clinical surgery in the University of Manchester.

Dr. James Gow, formerly headmaster of Westminster School, London, and author of "A short history of Greek mathematics" and of texts on the classics, died on February 16.

Nature records the deaths of the Rev. William Wilks, formerly vicar of Shirley, Croydon, known to scientific men for his work in horticulture, and of Sir Ernest Clarke, long secretary of the Royal Agricultural Society of England.

BY his will Professor Edward Emerson Barnard, for more than twenty-five years on the staff of the Yerkes Observatory, has bequeathed to the University of Chicago his astronomical books and to the observatory the medals that have been given him for astronomical work, as well as the small astronomical instruments now on exhibition in the observatory. To the university Professor Barnard has given his home and the grounds which belong to it which adjoin the grounds of the Yerkes Observatory, to honor the memory of his wife, Rhoda Calvert Barnard. Among the medals awarded to Professor Barnard for his work in practical astronomy are the Lalande, the Arago, and the Janssen gold medals from the French Academy of Sciences; the gold medal of the Royal Astronomical Society of Great Britain; and the Bruce gold medal of the Astronomical Society of the Pacific.

THE tricentenary of the birth of Blaise Pascal occurs on June 19, and according to *Nature* preparations have been made for celebrations in France on July 8-9. The President of the French Republic will attend the meetings, the chief of which will be a commemoration gathering, to be addressed by the Minister of Public Instruction and other members of the French Academy. There will also be a meeting at the summit of the Puy de Dôme, when a member of the Academy of Sciences will speak on the famous experiment carried out there, at Pascal's suggestion, of observing the barometric height at the summit and comparing it with that at the base of the mountain. A difference of three inches in the height of the mercury column was observed, giving Pascal justification for his conclusion that the column of mercury in the barometer is supported by the pressure of the atmosphere.

THE Paris Academy of Sciences has received a bequest of 750,000 francs from the late M. Massin, to establish a fund the income of which is to be used for the advancement of science.

FOR the observation of the solar eclipse on Catalina Island, California, September 10, 1923, a fund of $5,000 has been provided by Mr. William Wrigley, Jr., of Chicago, to finance the expedition, which will be under the supervision of Director Edwin B. Frost, of the Yerkes Observatory.

THE forty-third semi-annual meeting of the American Electrochemical Society will be held at the Hotel Commodore, New York City, from May 3 to 5. The technical program will include a whole-day session on the general topic "The production and application of the rarer metals." The arrangements for this session are in charge of Dr. F. M. Becket, of the Electrometallurgical Corporation, New York City. Another session will be devoted to a discussion of "Electrode potentials," led by Dr. William G. Horsch of the Chile Exploration Company, New York.

AT an adjourned meeting held in the rooms of the Royal Society in March, the Conjoint Board of Scientific Societies was formally dissolved. In view of this step, which became inevitable towards the end of last year, when the Royal Society withdrew its support, the work done by the various committees of the board has been terminated, and the World List of Scientific Periodicals had been vested in Dr. Chalmers Mitchell, Sir Robert Mond and Sir Arthur Schuster, as trustees.

SIGMA XI fellowships of a minimum value of $1,200 for the coming academic year are to be awarded on May 18. The fellowships are available for workers in other fields than physics, chemistry and the medical sciences. Preference will be given to candidates who have already taken their doctor's degree. Men and women are eligible. Applications should be accompanied by reprints of publications, letters from those competent to pronounce upon the ability of the candidate, a statement of the work the candidate proposes to do on this award and where such work is to be done. The fellowships carry no restrictions as to university or country. Applications must be made before May 15 and should be addressed to Dean Edward Ellery, Union College, Schenectady, N. Y.

THE Committee on Therapeutic Research of the Council on Pharmacy and Chemistry of the

American Medical Association will consider applications for grants to assist research in subjects which, in the opinion of the committee, are of practical therapeutic interest to the medical profession, and which research might not otherwise be carried out because of lack of funds. Requests should state the specific problem which is to be studied, the qualifications of the investigator, the facilities available to him, and, if work is to be undertaken in an established research institution, the name of the individual who will have general supervision. The committee will also appreciate offers from research workers to undertake investigations of questions which may be suggested by the council. Applications should be addressed to: Chairman, Therapeutic Research Committee, Council on Pharmacy and Chemistry, 535 North Dearborn Street, Chicago, Illinois.

THE American Pharmaceutical Association has available a sum amounting to $400 which will be expended after October 1, 1923, for the encouragement of research. Investigators desiring financial aid in their work should communicate before June 1 with H. V. Arny, chairman of the research committee, 115 West 68th St., New York, giving their past record and outlining the particular line of work for which the grant is desired.

WE learn from *Nature* that the Geological Department of the British Museum (Natural History) has acquired the paleobotanical collection of Dr. Dukinfield H. Scott. It comprises more than 3,000 microscopic slides, chiefly of British Carboniferous plants, on which most of Dr. Scott's own researches have been based. It is a direct continuation of the Williamson collection which was acquired by the museum in 1896.

THROUGH the kindness of Miss Ellen B. Scripps, Pomona College of Claremont, California, has purchased the herbarium of Marcus E. Jones of Salt Lake City, Utah. This collection is one of the most complete herbaria ever made for the arid regions of western North America and represents the accumulation of forty-five years of botanical activity on the part of Professor Jones. It contains about 200,000 sheets. In making his collection, Professor Jones has had the ecological point of view and has taken material so as to show the range of variation of the species included, in a very satisfactory way. Professor Jones accompanies the herbarium to its new destination. This herbarium, coupled with the C. F. Baker herbarium of about the same size, gives Pomona College one of the most important western collections. Botanists desiring to consult material should communicate with Dr. Philip A. Munz, Claremont, California.

A CORRESPONDENT writes: "While in Japan last October and November, Dr. David Starr Jordan made again a large collection—the third in his travels—of the fishes of Japan. The Imperial Universities took great interest in this collection and the Imperial University of Tokyo sent Professor Shigeho Tanaka to the extreme north of Japan and Dr. Yoshiro Wakiya to the south of Japan, while the veteran collector, Kuma Aoki, was directed to secure again everything possible from Sagami Bay, a sheet of water, which, thus far, has yielded more species of fishes and particularly of sharks than any other bay whatsoever. The Imperial University of Kyoto empowered Professors Kawamura and Yamamoto to be of all assistance possible, while the Imperial University of Sapporo in the far north sent out Messrs. Majima and Takayasu to examine the markets of the northwest and the northeast of the island of Hokkaido. Professor Ishikawa of the Imperial University of Tokyo also selected series of duplicates from the different universities. In all, four or five hundred species were obtained, some thirty-five of them new to science."

THE new motion picture film, "Evolution, from the birth of planets to the age of man," was shown on Friday, April 6, and again on Sunday, April 8, at the Brooklyn Botanic Garden. In addition to the public presentations, a special showing for biology students of the Brooklyn high schools was held on Friday, April 6. The film has been produced by Dr. Raymond L. Ditmars, of the New York Zoological Garden and edited by Dr. Benjamin C. Gruenberg.

A BILL introduced in the Arkansas legislature prohibiting the teaching of Darwinism, or any other form of evolution, in the public and state supported schools passed the house with practically no opposition but failed in the senate.

UNIVERSITY AND EDUCATIONAL NOTES

Princeton University will, subject to a life interest, receive over $500,000 by the will of Charles F. Williams.

Mrs. George Chase Christian, of Minneapolis, has given $250,000 to establish an institute at the University of Minnesota for the investigation and treatment of cancer.

Governor Baxter has signed a bill appropriating $895,000 to the University of Maine. The sum of $300,000 is appropriated for each of the fiscal years ending 1924 and 1925. For repairs and equipment $75,000 is provided for the first of the two years and $50,000 for the second. For an arts and science building $170,000 is appropriated, the expenditure to cover the two years.

Dr. Samuel Wesley Stratton, president of the Massachusetts Institute of Technology, will be formally inaugurated on June 11.

Dr. Oskar Klotz, recently engaged in reorganizing the pathological department of the University of Buenos Aires, under the direction of the Rockefeller Foundation, has been appointed to the chair of pathology of the University of Toronto Faculty of Medicine, left vacant by the death of Dr. John J. MacKenzie.

Mr. W. J. Perry has been appointed to a university readership in cultural anthropology and Dr. Bronislaw Malinowski to a readership in social anthropology in University College, London.

Professor A. V. Hill, of Manchester, has been appointed to the Jodrell chair of physiology in University College, London.

DISCUSSION AND CORRESPONDENCE

EINSTEIN DISPLACEMENT ON THE PLATES TAKEN BY THE CANADIAN PARTY AT THE AUSTRALIAN ECLIPSE

At the eclipse of the sun of September last two plates were taken to test for the Einstein effect, by the Canadian party at Wallal, western Australia. The focal length of the camera was eleven feet and the aperture of the lens was six inches. Dr. R. K. Young, of the Dominion Astrophysical Observatory, Victoria, B. C., who was a member of the party, has completed the measurement and computation of the plates, and the final results are given below. Over thirty stars were recognized on the plates and twenty-three were submitted to measurement, but eight of these were discarded in the course of the work, thus leaving fifteen. The measured displacement outward from the sun, as well as the expected amount according to Einstein's theory, are given in seconds of arc:

Measured +0.30, +0.44, +0.28, +0.25, +0.66, +0.22, —0.31, +0.12, —0.11, +0.23, +0.08, +0.06, +0.53, +0.77, —0.05.

Expected +0.48, +0.41, +0.40, +0.30, +0.28, +0.27, +0.24, +0.24, +0.24, +0.22, +0.22, +0.21, +0.21, +0.21, +0.18.

It will be seen that the displacement is undoubted and its amount is approximately that predicted by Einstein, but the results can hardly be considered decisive.

C. A. Chant

University of Toronto,
April 7, 1923

FUNDAMENTAL CLASSIFICATION OF GALLS

In the interest of gall science, attention is called to the following errors and deficiencies appearing in a recent number of Science which are related to the definition of two basic and highly significant terms.

Cook in a paper entitled "The Origin and Structure of Plant Galls"[1] states: "Küster has classified galls on the basis of presence or absence of cell differentiation into two great groups: (1) kataplasmas or those in which the structure is undifferentiated parenchyma, and (2) prosoplasmas in which there is a differentiation into other tissues."

This interpretation of Küster's valuable classification is highly misleading and incomplete. In Küster's latest general work dealing with galls[2] on page 283 one may find the following: Kataplasma structures are those which fall below the corresponding normal part in their differentiation. They show no constant size, form or time of development. They may occur as the deformation of an entire organ or as a local growth." In all of his earlier writings Küster presents the same idea that kataplasmas may range from structures suffering slightly inhibited differentiation to those homogeneous parenchyma types in which differentiation is wholly inhibited. Nowhere does Küster restrict the term to the latter "undifferentiated parenchyma" type.

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[1] Science, 57, 6-13, 1923.

[2] *Pathologische Pflanzenanatomie*, Jena, 1916.

In the same paragraph dealing with Küster's terms Cook accepts the statement of the writer that galls of Nematoda, Lepidoptera and certain other animal groups are kataplasmas. The vast majority of these galls show differentiated cells, especially xylem and phloem elements and are never wholly composed of "undifferentiated parenchyma."

Regarding prosoplasmas Cook says "they are structures in which there is a differentiation into other tissues." No explanation of what these "other" tissues are like is appended, so the statement is meaningless. Küster has defined prosoplasmas as gall structures which are characterized by definite size, form and time of development and possessing tissue characters (form and orientation characters chiefly) which are new, *i. e.*, they are not duplicated in the host plant. They range from poorly differentiated types to ones highly differentiated.

In this connection attention should also be called to Cook's error in classifying crown gall as a "low type of prosoplasma" because they possess "rather weak fibrous tissue." Küster on page 152 of the above mentioned work definitely, and to the mind of the writer correctly, includes all bacterial galls under "kataplasmas."

From the above definitions of Küster's terms basic to the fundamental classification of galls it is apparent that the assertion of Cook that "Küster has classified galls on the basis of *presence or absence of cell differentiation* into two great groups" is entirely wrong.

B. W. WELLS

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ATHLETICS AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE propagandist for any particular reform is always ready and willing to enlist in his holy cause any agency capable of lending the slightest assistance, however remote the real aims of such agency may be and regardless of the possibility that the agency in question may have its hands more than full with its own proper business. This reflection represents the reaction of one reader to Dr. W. E. Allen's article in a recent number of SCIENCE. No doubt athletics is in a bad way in some seats of learning—although I hasten to disclaim any reference here to the Scripps Institution—and Dr. Allen's continual italicization of the word *commercialized* gives the whole matter an ugly look, while providing a convenient loophole for the escape of the administrator or professor who regards athletic activities at his particular college as *non*-commercialized, but before the association embarks upon the crusade, conjointly, of course, with all other societies interested in the advancement of knowledge, it would be well to make sure of the facts and relations involved.

Is it in reality true that earnest undergraduates, strongly or even feebly determined upon becoming, say, consulting chemists to the soap industry or uncompromising foes of the corn ear-worm, are turned aside from these worthy aims and their slender means confiscated by burly fullbacks and members of the "sporting fraternity," detailed for such canvassing? Is this sort of thing characteristic of many institutions of high standing? We know from recently published statistics that the higher grades of students go largely into university teaching with its implied devotion to research, and I, for one, scout the notion that such undergraduates are in any danger whatever of being led permanently astray by athletes or athletics, *commercialized* or pure. If I may be permitted to draw upon my own experience and observations at Harvard, I would affirm that such an opinion is pure nonsense, since each student is naturally regarded by his fellows as a free agent in such matters. Let those who are unduly impressed with this rare if not wholly imaginary seduction of infant scientists remember that there is something to be said on the other side; *organized* athletics provides in its public spectacles one of the rare spots of high color in a somewhat drab civilization, it furnishes funds which give the whole student body apparatus and opportunity for interesting and therefore wholesome exercise, and it affords those capable of playing on the first teams a unique and invaluable chance to develop and display those extraordinary qualities of heart and mind required in their contests.

If an entirely unscholarly individual is hired to go to college so that the team may profit by his athletic prowess (as may still happen, I believe, in some sections of the country), if the coach pays the opposing captain to throw the game, if, worst of all, the student body in general is found prodigally to be wasting its money, time, interest and enthusiasm on sports to the exclusion of learning—then we have a black picture, indeed, but still indubitably a case for action by the administration of the institution concerned.

To enter this field, already under the anxious scrutiny and stern hand of those whose duty it is to guide such activities, would not only be a work of misguided supererogation, diverting the energy of the association from its proper aims, but it would, and quite properly, tend to alienate from science and scientists those students who, strange as it may seem to some honest souls, have at one and the same time a liking for sports, shared or watched, and for the study of nature. Let the association mind its own affairs, advancing the cause of science and ameliorating the conditions under which scientists labor, and recruits of promise will not be wanting.

H. M. PARSHLEY

SMITH COLLEGE

WAR EXPLOSIVES MISTAKEN FOR MINERALS

AT the close of the war, large quantities of explosives were distributed to the various states to be used mainly in bridge and road building. This material was frequently piled up in boxes in out of the way places where the containers sometimes became broken open and the explosives scattered some distance from the original source. The writer has personally observed one such case twenty-five miles south of Tucson, Arizona, where several tons of T. N. T. were kept for several weeks without guard or protection of any kind. Pieces of T. N. T. were picked up two or three hundred feet from the pile of boxes. As is well known, this substance turns yellow to brown on exposure to light and the stray pieces referred to above had so altered on the surface as to resemble rusty scrap iron. The pieces were of peculiar shape, some being cylindrical, evidently having been removed from unused shells. On breaking open some of the pieces with a hammer the material showed a fibrous radiating appearance not unlike some minerals. It does not seem strange, then, that occasionally these explosives should actually be mistaken for minerals. Moreover, in the case of more soluble substances such as picric acid, the material might become so mingled with sand or pieces of rock as to greatly increase the resemblance.

During the past year four distinct cases have been brought to the writer's attention where these explosives have presumably been mistaken for minerals. It has even led some men scientifically trained to seriously question whether these compounds might not actually occur as natural products. The first case was that of some earthy material stained with picric acid in such a manner as to almost exactly resemble carnotite. The material was received at the Arizona Bureau of Mines and the sender affirmed most emphatically that the substance was of natural origin. The bitter taste and the dyeing of a small piece of filter paper and comparing with a piece dyed with known picric acid was sufficient to identify the material.

The second case was that of a sample of whitish material, also received from a small town in Arizona by the Bureau of Mines. It was mingled with a very small amount of foreign matter and on testing was found to be T. N. T. (trinitrotoluene). In this case, on further correspondence with the sender, it was admitted that T. N. T. had been used the previous year near the locality concerned, and that some of the men interested in having the material tested had suggested that it might be an explosive. Had this information been included in the first letter a considerable amount of labor would have been saved in the identification.

The other two cases of widely different localities (New Mexico and Colorado) were called to my attention by Dr. S. C. Lind, of the U. S. Bureau of Mines. In both of these cases the senders were, as stated by Dr. Lind, "not willing to accept the view" that the picric acid had been introduced accidentally.

The abundance of these explosives after the war, and the lavish way in which the government has distributed them for public service, together with the careless manner they have been handled in the road camps, is sufficient to explain the occasional finding of explosives under conditions which cause them to resemble minerals. It is not believed that these substances could be developed by natural agencies.

F. N. GUILD

UNIVERSITY OF ARIZONA,
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PARTIAL LIST OF BIOLOGICAL INSTITUTES AND BIOLOGISTS DOING EXPERIMENTAL WORK IN RUSSIA AT THE PRESENT TIME

THE list below was compiled by the undersigned during a trip to Moscow and Petrograd in August, 1922, taken for the purpose of investigating the biological sciences and scientists there and of reestablishing communication with them. Unfortunately, there was not sufficient time to make the list nearly complete. At all of these institutes research is being engaged in actively and articles are being published, but the work is much hampered on account of the lack of scientific literature from other countries, particularly from America. One of the greatest services that could be done to the Russian scientists at present is to help them to gain knowledge of the work which is being done in the west, and the list is therefore published to inform American scientific men of the addresses to which their reprints, and, wherever possible, the back numbers of their periodicals may be sent. Owing to the rather high centralization of Russian science, articles directed to these institutes will reach a large number of the people engaged in a given line of research. The articles may be mailed directly to addresses given, since postal communication has been reestablished, but they are to be addressed to the institute rather than to the person as such, in order to be sure that the Russians will not have to pay an import duty. Of course, the name of the person who would be most interested may be designated, even though the article is not sent to him personally.

H. J. MULLER

THE UNIVERSITY OF TEXAS

Bureau of Applied Botany, Professor N. I. Vavilov, director, and numerous others, Morskaya 44, Petrograd.

Scientific Institute of Ministry of Public Health, Professor Terasevitch, general director. This general organization comprises the following 8 institutes:

(1) Biochemical Institute, Professor A. Bach, director, and numerous associates, Vorontsovo Polye 8, Moscow.

(2) Institute of Control of Vaccines (including also station in country), Professor Terasevitch, director, and associates, Sivtsev Vrazhek 41, Moscow.

(3) Institute of Experimental Biology (including also 2 stations in country), Professor N. K. Koltzof, director, Sivtsev Vrazhek 41, Moscow; Professor S. N. Skadovsky, head of Hydrobiology Station; Professor V. N. Lebedof, head of Genetics Station; Dr. A. S. Serebrovsky (genetics); Dr. I. G. Kogan (sex hormones); Dr. D. D. Romashof (genetics and biometry); Dr. P. I. Shivago (histology); Drs. A. J. and S. S. Tchetverikov (entomology), and numerous others; address of all: Sivtsev Vrazhek 41, Moscow.

(4) Institute of Physiology of Nutrition, Professor Tchaternikof, director, and associates, Sivtsev Vrazhek 41, Moscow.

(5) Institute of Microbiology, Professor V. Barikin, director, Miss N. Kritch and other associates, Kudrinsknya-Ploshadj 8, Moscow.

(6) Institute of Sanitary Epidemiology, Professor Diatropof, director, and associates, Kudrinskaya-Ploshadj 8, Moscow.

(7) Institute of Tropical Medicine, Professor E. Martsinovsky, director, Kudrinskaya-Ploshadj 8, Moscow; Dr. Sh. Moshkovsky (chemotherapy, cultures, chemistry of histological staining, etc.); Professor I. Smorodintsev (enzymology); Dr. A. Adova (enzymology); Professor K. Skriabin (helminthology); Dr. P. Popov (helminthology and entomology); Dr. N. Shakov (malaria cultures, etc.); Dr. W. Povshina and Dr. A. Shtchurenkova (trichomonas, etc.); Dr. A. Metielkin (protozoan parasites); address of all: Kudrinskaya-Ploshadj 8, Moscow.

(8) Institute of Tuberculosis, Professor Varabiof, director, and associates, Kudrinskaya-Ploshadj 8, Moscow.

Institute of Biophysics (and physics), Professor P. P. Lazaref, director, and numerous associates, 3rd Miuska Ulitsa, Moscow.

Experiment Station for Investigation of Domestic Animals, Professor I. I. Ivanov (sperm studies), Khlebny Pereulok 9, 9, Moscow.

Central Institute of Work, Dr. K. Ch. Kektcheyev, director of physiological investigations, and associates, Moscow.

Agricultural Academy, Madame Nikolayeva (cytology), Petrovskaya-Razumovskaya, Moscow.

Zoological Institute, Professor Michael Savadovsky (sex studies); Professor Savadovsky (general biology), Zoological Garden, State University, Moscow.

Zoological Museum, Professor Koshevnikov (entomology), State University, Moscow.

Laboratory of Experimental Zoology and Genetics, Professor I. A. Philiptchenko (genetics), Dr. Vitaly M. Isayev (experimental zoology), First State University, Vassily Ostrov, Petrograd.

QUOTATIONS

FREE MUSEUMS AND GALLERIES[1]

A QUESTION addressed to Mr. Baldwin by Sir John Butcher yesterday revives the doubt whether it is wise to demand an entrance fee of visitors to the British Museum. The proposal, contained in the Increase of Fees Bill, which has passed its second reading, is that the public should pay for admittance the sum of sixpence on four days of the week; and it is calculated that an annual sum of £6,000 will thereby be raised for the finances of the museum. The government appear to entertain the belief, or perhaps only a pious hope, that the number of visitors will not be diminished in consequence; but the analogy of the National Gallery will not serve them. The entrance fee there, on students' days, is charged in order mainly to keep the general public out and leave the gallery more free to students; and there is no question that it has that effect. It may be assumed, therefore, that fewer people will go to the museum in future if the tax is imposed. We can not but hold the proposed tax to be a retrograde step. It is contrary to the traditions of the museum, contrary to the tendency of the age to regard museums and galleries as institutions of real educational value, and contrary to the whole educational policy of the country, which is to put knowledge more and more at the free disposal of all. It is a direct tax on knowledge.

Nobody can hope to understand much of what he sees at the British Museum, if he sees it only once, or attempts to race around all the rooms in an hour or two. Beauty, of which the museum is full, does not yield up its secret forthwith. But to any determined amateur, with the necessary curiosity and time at his disposal, the secret will reveal itself in the end, and he will be the better citizen for it. There is no reason why almost any Londoner should not, if the museums and galleries were always open for nothing, be able to constitute himself a connoisseur of beauty. The National Gallery, which has fewer free days than formerly, is without rival in the world; all that it needs is a public that understands what it has to confer—a catholic appreciation of painting, of all schools—after the requisite number, more for some and fewer for others, of visits. It is the same with the British Museum at Bloomsbury, a cathedral of the humanities, and at South Kensington of nature, also unrivalled. Only a narrow policy would seek to put a limit on the free entry of the general public into both places. Culture, if it is to exert its humanizing influence, must be spread in the widest commonalty. The exquisite shapes in the Tanagra Room, the stately avenue of books in the King's Library, the stones that still speak of man's struggle with the mastodon, are too good to be treated as if they were part of a circus or a cinema show. They and their companion collections in the national possession can not be looked at and visited too often. If funds be wanted for their upkeep, let vulgarity find them. It is ubiquitous, and could bear the tax without feeling it. But let the two principal national museums be open all days of the week free to all. At a great cost these collections have been founded and assembled; they were meant for the general enjoyment, and those who need their soothing and kindly influence most in their lives are often those who can least afford a fee to go to see them. When so many means of locomotion now converge on central London, it would be a monstrous paradox if what is most worth seeing there were made more difficult of approach.—*The London Times.*

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[1] The British government has withdrawn its plan to charge an entrance fee to the British Museum.

CHEMICAL NOMENCLATURE[1]

1. In naming a compound so as to indicate that oxygen is replaced by sulfur the prefix *thio* and not *sulfo* should be used (sulfo denotes the group SO_3H); thus, HCNS, *thio*cyanic acid; H_3AsS_4, *thio*arsenic acid; $Na_2S_2O_3$, sodium *thio*sulfate; $CS(NH_2)_2$, *thio*urea. The only use of *thio* as a name for sulfur replacing hydrogen is in cases in which the sulfur serves as a link in compounds not suitably named as mercapto derivatives; thus, $H_2NC_6H_4SC_6H_4NH_2$, thiobisaniline. *Hyposulfurous acid*, not hydrosulfurous acid, should be used to designate $H_2S_2O_4$.

2. The word *hydroxide* should be used for a compound with OH and *hydrate* for a compound with H_2O. Thus, barium hydroxide, $Ba(OH)_2$; chlorine hydrate, $Cl_2.10H_2O$.

3. Salts of chloroplatinic acid are *chloroplatinates* (not platinichlorides). Similarly salts of chloroauric acid are to be called *chloroaurates*.

4. Hydroxyl derivatives of hydrocarbons are to be given names ending in *—ol*, as glycer*ol*, resorcin*ol*, pinac*ol* (not pinacone), mannit*ol* (not mannite), pyrocatech*ol* (not pyrocatechin).

5. The names of the groups NH_2, NHR, NR_2, NH or NR should end in *—ido* only when they are substituents in an acid group, otherwise in *—ino;* thus, MeC(:NH)OEt, ethyl im*ido*acetate; $NH_2CH_2CH_2CO_2H$, β-am*ino*propionic acid (not am*ido*propionic acid); $NHPhCH_2CH_2CO_2H$, β-anil*ino*propionic acid; $CH_3C(:NH)CO_2H$, α-iminopropionic acid.

6. Hydroxy—, not oxy—, should be used in designating the hydroxyl group; as *hydroxy*acetic acid, $CH_2(OH)CO_2H$, not *oxy*acetic acid. *Keto—* is to be preferred to *oxy—* to designate oxygen in the group —CO—.

7. The term *ether* is to be used in the usual modern acceptation only and not as an equivalent of *ester*.

8. Salts of organic bases with hydrochloric acid should be called *hydrochlorides* (not hydrochlorates nor chlorhydrates). Similarly hydrobromide and hydroiodide should be used.

9. German names ending in *—it* should be translated *—ite* rather than *—it;* as permut*ite*. If it seems desirable to retain the original form of a trade name it should be placed in quotations, as "Permutit." Alcohols such as dulcitol (German Dulcit) are exceptions.

10. German names of acids should generally be translated by substituting *—ic acid* for "—säure." Some well-established names are exceptions, as Zuckersäure (saccharic acid), Milchsäure (lactic acid), Valeriansäure (valeric acid), etc. When the name ends in "—insäure" the translator *may* substitute *—ic acid* unless another acid already bears the resulting name; thus, Acridinsäure, acridic acid, but Mekoninsäure, meconinic acid, because meconic acid (Mekonsäure) is different. Names ending in "carbonsäure" are to be translated —carboxylic acid (not —carbonic acid).

March 28, 1923

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[1] Adopted by the Nomenclature Committee of the American Chemical Society and that of the London Chemical Society.

FISHERIES RESEARCH

The British delegates to the International Council for the Exploration of the Sea, Mr. H. G. Maurice, assistant secretary of the Board of Agriculture and Fisheries, and Professor D'Arcy Thompson, scientific member of the Fishery Board for Scotland, have presented their report on the meeting of the International Council held in Copenhagen last September.

According to a report in the London *Times* their instructions were to press for the development of the work of the Council along practical lines, with a definite bearing on fisheries, to try to assign problems to the countries which could deal with them most effectively, and to ask for some definite pronouncement on the plaice question. They report success in each of these directions, and state that in view of the financial difficulties, the preceding year's work had been very encouraging.

The countries represented were Belgium, Denmark, Finland, France, Great Britain, Holland, Norway, Portugal and Sweden. Full details of the proceedings will be published by the Council; the delegates now direct special attention to the work of the Herring Committee, the Cod and Haddock Committee, the Committee of the Atlantic Slope, in which Great Britain has immediate interest, and to the plaice question, on which the council arrived at a unanimous decision.

The Norwegian Government is to be asked to take responsibility for, and bear the expenses of, the administration of the Herring Committee. The program of researches on herring is divided into eleven groups, which have been allotted to different nations. England is to take a special interest in the collection of statistics, investigation of younger stages of herrings and their distribution, location and characteristics of spawning grounds, and hydrographical and biological observations where fishing is going on and in the spawning grounds. Scotland, which has a deep interest and special opportunities, is to take a share in all the sections of the herring program.

There has been a similar distribution of the researches to be undertaken with regard to cod and haddock. England is to take her share in practically all the sixteen sections of the program, but is to hand over English haddock statistics to be dealt with by Scotland, and in return is to deal with the Scottish cod statistics.

The Atlantic Slope Committee is to investigate the hydrography and biology of the Atlantic Slope area from Gibraltar to Rockall. The work is to be shared by England, Scotland, Ireland, France and Portugal, and is to be carried out chiefly by regular cruises undertaken by research vessels.

Work on plaice has been going on for twenty years, Great Britain having taken a lead in it, with great help from Denmark and Holland, and from Germany before the war. There have also been valuable independent investigations made more recently by Germany. The recommendations adopted by the council were in effect those suggested by the committee.

The council agreed that there was clear evidence as to the possibility of serious depletion of plaice fisheries by fishery operations, and that such had actually taken place before the war. The forced restriction of fishing during the war had been followed by a large increase in average size and in numbers, but there is already evidence of a decline of the stock resulting from the resumption of intensive fishing. This decline is likely to be progressive; protective measures will become necessary in the near future. They recommend, therefore, the prohibition of fishing by steam trawlers and motor vessels of more than 50 h.p. throughout the year along a zone from the Continental coast to the 12-fathom line from about the Hook of Holland to the middle of Denmark, and, except during the months of April, May and June, to a 15-fathom line from Heligoland to the northern limit of the inner zone.

They suggest that measures of restriction should be reviewed three years after their inception, and point out that, although it is a matter for consideration by individual governments, the enforcement of restrictions will be difficult without the sympathetic cooperation of the trade. Finally, they urge a method of improving the fisheries suggested many years ago by Professor Garstang—the transplantation on a very large scale of small plaice from regions where they are overcrowded, to regions such as the Dogger Bank, difficult to reach by natural migration, and yet affording an abundant supply of food and suitable conditions for rapid growth.

The British delegates call special attention to the need of securing the cooperation of the British fishing industry, and advocate a preliminary discussion of the administrative aspects of the question by representatives of the departments concerned, the Admiralty and the Board of Trade, to be followed by conference with the industry. They also point out that when the government had come to a conclusion as to what measures they were prepared to advocate, there should be further conference with the other governments concerned, including Germany.

SPECIAL ARTICLES

CRITICAL POTENTIALS OF THALLIUM VAPOR

The only published results of direct measurement of critical potentials for elements of the third column of the periodic table are the data on thallium vapor obtained by two of the authors[1] several years ago. The measurements given in Table III and Fig. 3, *l.c.*, showed inelastic collisions without ionization at intervals of 1.07 ± .1 volts and ionization at an *applied* potential of 6.6 volts. At that time the 1.07 volt impact was thought to be related to the infra-red line λ 11513 here designated as $2s—3p_2$. After correcting the 6.6 volt impact for initial velocity, the value 7.3 volts

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[1] Foote and Mohler, *Phil. Mag.*, 37, p. 33, 1919.

TABLE I.

Volts	Excitation Transition	Radiation Transition	Wave-length emitted
0.962	$2p_2 \rightarrow 2p_1$	None	
3.269	$2p_2 \rightarrow 2s$	$2s \rightarrow 2p_2$ $2s \rightarrow 2p_1$	3776 A 5350
4.47	$2p_2 \rightarrow 3d_{1,2}$	$3d_2 \rightarrow 2p_2$ $3d_1 \rightarrow 2p_1$ $3d_2 \rightarrow 2p_1$	2768 3519 3529
6.082	$2p_2 \rightarrow \infty$	Arc spectrum	

was obtained for the ionization potential, which corresponded to no known series limit. These data are inconsistent with the new Bohr theory of atomic structure, and for this reason it has been suggested[2] that a redetermination of the critical potentials of thallium was highly desirable.

Thallium shows a doublet spectrum quite similar to the alkalis except that the highest wave number in the spectra of the latter is $1s$, while the highest known term for the metals of Group III is $2p_2$. Bohr's theory indicates that such a condition is to be expected and that $2p_2$ represents the normal state of the atom for these metals. Hence the ionization potential should be determined by this term. A recent paper by Grotrian[3] on the absorption spectra of thallium and indium has confirmed this view in a most conclusive manner.

We have redetermined the ionization potential of thallium by the Lenard method. The applied potentials were corrected (1) by measuring the velocity distribution of electrons and (2) by introducing mercury vapor and measuring the difference in the ionization potentials of the two elements. The two methods gave 6.02 and 6.1 volts respectively, with a weighted mean of 6.04 ± .1 volts. The limit $2p_2 = 49264$ corresponds to 6.08 volts in excellent agreement with the observed value.

Inspection of the previously published data shows immediately the source of error in the value of the ionization potential there given. The measured applied potential was corrected by comparison with the potential of the first inelastic collision. The first distinct point occurred at 1.55 volts, but in a single case[4] there was a slight indication of inelastic impact one volt lower. We concluded that this point was real, and that the distinct resonance at 1.55 was actually the second resonance collision. Our more precise recent experiments show that this faint inflection was due to an accidental variation in current, and it is unfortunate that we were misled in the interpretation of data, which, with this single exception, now appear to be fairly precise. Since actually the 1.55 volt collision, observed in our work of four years ago, is the first resonance point, the corrected ionization potential is readily seen to be 6.12 volts, a value entirely concordant with the more accurate work described above.

The resonance potential of 1.07 volts can not be ascribed to λ 11513, $2s-3p_1$, as this line is now known to be neither a resonance line nor an absorption line for the normal atom. The smallest quantum of kinetic energy absorbable by the normal thallium atom in its $2p_2$ state corresponds to $\nu = 2p_2 - 2p_1, = 7793 \Bumpeq 0.96$ volts. This is, within the error of measurement, in agreement with the observed value 1.07 volts. We have accordingly a peculiar type of resonance potential[5] since, unlike the metals of Groups I and II, the resonance collision is not followed by the emission of the corresponding single-line spectrum. The emission of $\nu = 2p_2 - 2p_1$ is forbidden by the principle of selection for azimuthal quantum numbers. Hence collisions of this

TABLE 2

CRITICAL POTENTIALS FOR ALUMINIUM SUBGROUP (IN VOLTS)

Element	Ionization		Resonance Potentials		
	$2p_2$	$2p_1$	$2p_2-2s$	$2p_2-3d$	$2p_2-2p_1$
Al	5.960	5.946	3.129	4.004	0.014
Ga	5.973	5.871	3.060	4.294	0.102
In	5.761	5.488	3.009	4.06	0.278
Tl	6.082	5.120	3.269	4.47	0.962

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[2] "Origin of Spectra," Foote and Mohler, page 65.

[3] Grotrian, *Zeit. f. Physik.*, 12, p. 218, 1922.

[4] l. c., Fig. 3, curve 9.

[5] A somewhat similar phenomenon is exhibited by the lower resonance potential of helium.

type produce a metastable form of thallium.

In addition to this type of collision there should be at least two other resonance potentials and each of these will give rise to several lines in emission. Table I shows the probable stages in the excitation of normal thallium.

Metastable thallium, which Grotrian shows may be produced by heating to 800°C., should have resonance potentials about one volt lower, corresponding to $\nu = 2p_1 - 2s$ and $\nu = 2p_1 - 3d_{1,2}$.

One may now predict with certainty the critical potentials for other elements in this group as shown in Table II. Further work with these vapors is in progress.

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CROSS-INOCULATION STUDIES WITH CUCURBIT MOSAIC

CONTINUED cross-inoculation studies with cucurbit mosaic have shown that the disease may be transmitted to nearly all species of the cucurbits and to a number of plants in families other than the cucurbitaceæ. The cross-inoculation experiments with the cucurbits, described in an earlier paper,[1] have been continued until we now have 8 genera, 23 species, 8 varieties and 96 horticultural varieties which are known to be susceptible to the disease. This list includes a number of species and varieties from Europe, Asia and Africa. With the exception of the genus *Citrullus,* all of the cucurbits thus far inoculated have proven susceptible to mosaic. Inoculations in this genus have included twenty varieties of watermelon and citron, but infection has been secured only in the case of the green-seeded citron,[1] which appears to be susceptible to the disease.

Cross-inoculations with plants of other families, as earlier reported, gave some evidence that cucurbit mosaic was transmissible to martynia *(Martynia louisiana),*[1] pepper *(Capsicum annuum),*[2] milkweed *(Asclepias syriaca),*[2] and pokeweed *(Phytolacca decandra).*[3] Further studies have shown that cucurbit mosaic is readily transmissible to these hosts and back to the cucumber. The disease has also been transmitted from milkweed to both martynia and pepper and back to the milkweed. The writers have found that the most uniformly successful method of inoculation consists in the transfer of aphids from a mosaic plant to the plant inoculated, but successful results have also been obtained by artificial inoculation with the crushed tissue or expressed juice of mosaic plants.

We have also found that cucumber mosaic is readily transmissible to tobacco through the pepper and *vice versa,* the pepper apparently acting as an intermediate host. Numerous direct inoculations from cucumber to tobacco have been unsuccessful up to the present. Elmer,[4] however, reports that he has secured infection on cucurbits inoculated with tobacco mosaic and *vice versa.*

A continuation of the earlier experiments with the potato[3] has shown that cucumber mosaic is apparently transmissible to this host. We have secured a high percentage of infection in several series of inoculations to the cucumber from potato plants which had earlier been inoculated with cucumber mosaic. Tubers from potato plants which were inoculated from the cucumber in 1921 developed symptoms of mosaic when grown in the greenhouse during the past winter. Experiments also indicate that potato mosaic may possibly be transmitted to the pokeweed. In the latter experiments the potatoes used were from mosaic stock secured in northern Wisconsin. These experiments are still in a preliminary stage, however, and are being continued at the present time. During the past summer it has been found that cucumber mosaic may also be transmitted to the pigweed (*Amaranthus retroflexus*) and to a cultivated ground cherry (*Physalis sp.*).

A complete report of this work is being submitted for early publication.

S. P. DOOLITTLE
M. N. WALKER

U. S. DEPARTMENT OF AGRICULTURE
AND WISCONSIN AGRICULTURAL
EXPERIMENT STATION.

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[1] *U. S. D. A. Bull.* 879, 1-69, 1920.

[2] *Phytopathology,* 11, 47, 1921.

[3] *Phytopathology,* 12, 42-43, 1922.

[4] SCIENCE, 56, 370-373, 1922.

A FURTHER NOTE ON THE FRESH-WATER MEDUSA

IN SCIENCE of December 8, 1922, Professor H. Garman reports some later observations on the medusæ of Benton Creek, Kentucky, where they were found in large numbers in the late summer of 1917 as they had been the previous summer. In the present note he reports that careful search for the hydroid stage at several times had been without success, but mentions finding in September, 1922, colonies of *Cordylophora lacustris,* a well-known hydroid of fresh and brackish waters, and remarks upon its occurrence in " a new locality in which it is associated in a way with Craspedacusta," though adding in a foot note that "a medusa stage is believed not to be produced by this hydroid."

It seems to the writer that it may be well to briefly summarize present knowledge of this very interesting problem in order that subsequent findings may be properly correlated with what has already been established.

Cordylophora lacustris: This hydroid was first described by Allman in 1844 (*Annals of Nat. Hist.,* vol. xiii, p. 330, and later in his "Monograph of Gymnoblastic Hydroids," 1871, p. 252). Hincks described its life history (*Ann. Nat. Hist.,* 1853, and still later in his History of Brit. Hydroid Zooph., 1868). Details of its habitat have been given from time to time by scores of zoologists, but the fullest account of its development is that of F. E. Schulze in 1871 in a memoir of some 52 pages with six lithograph plates. Its life history is therefore as clearly established as that of any known hydroid. Of course, one of its very interesting peculiarities is its adaptability to both salt and fresh waters, and it has quite a wide and varied distribution, records of its occurrence in inland waters having been made by many observers. Hence there is no special significance in its occurrence in the Kentucky creek and in the same locality as that of Craspedacusta several years prior.

Microhydra Ryderi Potts: This very remarkable hydroid was discovered by Mr. Edward Potts in 1885, and was described by Dr. J. A. Ryder (*Amer. Naturalist,* vol. 19, p. 1232) at the request of Mr. Potts, who supplied the material and data as to its localities. The untimely death of Dr. Ryder soon after this delayed further accounts for several years. In 1897 Potts was fortunate in having actually observed the development and liberation of its medusa stage, and this he repeatedly confirmed by studies in subsequent years.

A later and final account of this hydroid by Potts appeared in *The Quar. Jour. Micro. Science,* vol. 50, 1906, including notes by Lankester, and drawings from several authors, making a comparatively complete account of the entire life history of the hydroid. As will be found in the description given, the size of the hydroid stage is extremely minute as suggested by the generic name given to it. Its size as given is only about 0.5 mm. in height, by less than one half that in diameter. Search for it would therefore be like that for the proverbial needle in a haystack.

It is doubtless due to this feature of minuteness that this hydroid has been so rarely seen. Added to this feature is also that of its anomalous characters of structure, for example, absence of tentacles, hydrorhiza, etc., which add to its disguise. Unless one were familiar with these facts, or had seen descriptions and drawings, it would be quite easy to overlook organisms such as these even when knowing something of the objects of search. One other feature also further obscures the hydroid, its very quiescent or sluggish habit, often being motionless for some time, and its motion unlike that of Hydra or other hydroid forms as commonly known. Further accounts along this line will appear under the following section.

Craspedacusta sowerbii Lankester (*Limnocodium sowerbii* Allman). Under these names are designated the fresh water medusa first made known by Lankester, and at the same time by Allman, in 1880; but that given by Lankester having been first published takes precedence. Its discovery was first made by Mr. Sowerby, secretary of the botanical garden of Regents Park, London, who supplied specimens to Professor Lankester. The fact that the specimens were found in large numbers in the tank where the giant water-lily, Victoria regia, was grown, having been brought from South America, led to the inference that the medusæ had been brought also from the same region of the tropics. As is now well known, this inference is probably erroneous, since the wide distribution in other localities, most particularly in the United States, where they have been found in natural waters, lakes and creeks, accounts of which the present writer has given, first in SCIENCE, November 8, 1907, and later in the *Biological Bulletin*, vol. xiv, 1908, p. 304. Its next occurrence is that reported by Professor Garman in SCIENCE, December 15, 1916, and finally that described by the present writer in SCIENCE of October 31, 1919, and the note by Garman referred to in the opening paragraph of this paper. The following letter from Dr. R. E. Coker, of the Bureau of Fisheries, Washington, D. C., establishes still an additional locality for Craspedacusta in the United States:

> Your somewhat recent paper in SCIENCE concerning fresh-water medusæ recalled to my mind the fact that I had not acquainted you with the examples which I collected on September 16, 1918 in Augusta, Georgia.
>
> During a very brief stay in Augusta, my attention was called to the medusæ by Mr. Schultze, of the Public Health Service at that time, formerly with the Berkman nurseries of Augusta, Georgia, who during the previous few days had observed them abundantly in a concrete pool in the corner of the yard of the Catholic church. He was, of course, interested in knowing what they were, and properly suspected them to be jelly-fish.
>
> The pool was about 14 feet in diameter and 2½ feet deep; the intake was in the center, arising, I am told, from the city water system. The normal over-flow pipe was stopped up and the water was running over slowly on one side. There were no large plants, but the side walls were covered by a coating of sediment about half an inch thick and greenish in color. The medusæ were very active in a bottle of water, making as many as 114 strong pulsations to the minute. Five specimens were kept in a small bottle with some of the sediment from September 16 to 23, inclusive, when they died in my office in Washington. About a dozen examples were preserved in alcohol, the only thing available for the purpose at that time, and subsequently deposited in the United States National Museum under its accession number 62,830. They were presumably *Craspedacusta sowerbii.*

For a long time the medusa stage was the only aspect of the organism known. But in 1884 Bourne described a hydroid stage (*Proc. Royal Soc.*, London) and still later an extended account by Fowler was given (*Quar. Jour. Mic. Sci.*, vol. 30, 1890, p. 507, plate 32, nine figures) which includes an account of the liberation of the medusa and some details of its structure. Fowler's polyps were larger than those of Microhydra described above, but otherwise very similar. These accounts, with those of Lankester (*Quar. Jour. Mic. Sci.*, vol. xx, p. 351) will afford an excellent résumé of the life history up to that time. But it yet remains for further investigations to complete full and unquestioned life history of these most interesting organisms.

Another very interesting feature associated with the appearance and distribution of these medusæ is the anomalous and erratic aspects of their occurrence and, to a less degree, their more or less sudden disappearance. This point was very marked of their presence in the tanks of the Regents Park as reported by Bourne, Fowler and others. This was equally marked in the history of the medusæ in the Washington aquaria as I have shown. It was likewise noted in those of Benton creek, Kentucky, at the close of the first summer, *i. e.*, 1916, to which the present writer referred, and which Professor Garman, in his recent note in SCIENCE, December 8, 1922, deems an error. But this referred only to the particular feature here cited and was based on a letter from Professor Garman of December 21, 1916, in which he states: "You may be interested in knowing that on September 30, after I secured the medusæ, another trip was made to the creek with a view to learning something further of the organisms. I examined the banks from above backwater down to the mouth of the creek, but found neither medusæ nor colonial forms. A rain had followed my first visit, so that the stream was much above its former level and was muddy. This condition may account for the failure in the second trip to secure specimens." This last report of Garman establishes the recurrence of the medusæ in Benton Creek in 1917, though not since then. Advices indicate that at the Elkhart locality these medusæ have thrived without interruption since their first discovery some five years ago.

In his earlier account of the medusæ, the writer showed those of Europe and the United States to be identical. Not having studied the hydroid stages he had only the descriptions of Bourne and Fowler of the hydroid they regarded as that of Craspedacusta, and those of Ryder and Potts of this stage of Microhydra, upon which to base an opinion. The accounts supply fairly strong evidence that these stages also show close affinities if not actual specific identity, though there yet remain points of ontogeny to be cleared up before a final pronouncement can be made.

Mayer ("Medusæ of the World," vol. ii, p. 366) states that Potts had declared their identity. Of this I find no evidence whatever, either in his papers or in personal correspondence with the writer. On the contrary, he specifically holds otherwise. "In concluding, it is hardly necessary to invite the attention of scientists to the fact that we have, in these three fresh-water forms, an equal number of species, no one of which has been conclusively studied; that their appearance in three of the five grand divisions of the earth points very plainly to the probability that closer methods of research may very soon discover others in familiar but unsuspected places; that, whatever we may believe as to the origin of *Limnocodium sowerbii*, it is hardly possible to doubt that *Limnocnida tanganyicæ* and *M. ryderi* are native to the districts in which they have been found, and that, unless or until the polyps of Bourne and Parsons have been seen to produce the Limnocodium, it is quite within the limit of possibility to suppose that they have had their origin in the Thames, or from any other source from which the tanks in which they were found may have been filled."

Browne (*Quar. Jour. Mic. Sci.*, vol. 50, p. 638) has expressed rather strong dissent on this point, especially based upon the features of the hydroid stages. Like the present writer, he had only the accounts already cited. While appreciating the points of objection raised, yet I am not convinced of their validity. It should not be overlooked that the material of Bourne and Fowler was that taken from the artificial habitat of the tanks in Regents Park, while that of Potts was from the natural outdoor habitat of rapidly flowing waters. With these points of contrast in mind, allowance must be made for habitudinal variations which, in these organisms, may often be quite marked. But, as stated above, it is not till full and convincing ontogenies are clearly established that a final verdict can be declared.

CHARLES W. HARGITT

SYRACUSE UNIVERSITY
JANUARY 30, 1923

PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Financial Report of the Secretary-Treasurer for the calendar year ending December 31, 1922

Cash balance from preceding year		$1,526.54
Receipts for 1922		
From permanent secretary's office	$1,144.00	
From affiliated societies	125.00	
From dues and fees	368.00	
		1,637.00
		$3,163.54
Expenditures		
Dues remitted to permanent secretary's office	$ 195.00	
Supplies	20.13	
Salary, 1922	825.00	
Salary, 1921	75.00	
Office assistance	300.00	
Postage	20.00	
Telephone and telegraph	52.49	
Expense, general	5.00	
Expense, travel	99.27	
Membership campaign	113.00	
Conservation of marine life committee (stationery)	22.00	
		1,726.89
Cash balance, January 1, 1923		$1,436.65

Comparative Statement of Receipts and Disbursements and of Membership for the years 1921 and 1922

	1921	1922
Received from the permanent secretary's office:		
Account 1921-1922 dues	$1,689.00	
Account 1920 dues		$ 8.00
Account 1921 dues		22.00
Account 1922 dues		462.00
Account 1923 dues		652.00
	$1,689.00	$1,144.00
Received from societies and members:		
From affiliated societies	125.00	125.00
From new members, dues	290.00	195.00
From new members, initiation fees	280.00	173.00
Annual disbursements	$1,404.63	$1,581.89
Membership:		
New members enrolled	55	39
Total enrollment at end of year	990	1094

SCIENCE

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THE METHODS OF IMMUNOLOGY[1]

DURING recent years your president has been denied the opportunity of continuing research work, by reason of constantly increasing administrative responsibility. Any one of you who has had similar experience will understand the sacrifice involved in being divorced from immediate participation in investigations. For the reason stated I am unable to present to you any piece of research, but in lieu of this I shall venture to tell you briefly of the great aid afforded by your own particular branch of biological science to those of us who are confronted with the responsibility for the final supervision of certain medicinal agents.

It is a fact that governments (and particularly our own) have singled out from the great list of remedial and prophylactic preparations those susceptible of examination by immunological methods, and have placed in the hands of certain agencies control procedures applicable to those agents and unthought of in connection with other groups of therapeutic preparations. Let me make this clear by an example:

At present no one may exploit in interstate traffic in the United States serums or vaccines for the treatment of cancer, but there is nothing to prevent any one from exploiting a treatment for cancer made of something other than a serum or vaccine, provided only that the labels on the preparation conform to the requirements of the food and drug enforcement officials.

In our country Congress in 1902 recognized the importance of, and the special dangers and needs in connection with, biologic products, and in the intervening period the hygienic laboratory of the United States Public Health Service has had exceptionally good opportunities of becoming familiar with the difficulties involved, as the control measures are exercised through that institution.

---

[1] Presidential address before The American Association of Immunologists, Boston, March 29 and 30, 1923.

I shall now briefly review the procedures in connection with the preparations in which biologic control is exercised.

SERUMS

We naturally consider first the *antitoxins* which have well-recognized potency standards. I shall dismiss diphtheria and tetanus antitoxins by saying that the standards for these are so satisfactory and so well known that the distribution by the central testing laboratory of standard serums for comparison enables producers to titrate their products satisfactorily, and, beyond occasional testing of market samples for comparison of results with those secured by manufacturers, no further measures are necessary.

It is less well known that there has been established a standard for botulinus antitoxin of types A and B, and a standard for the antitoxin against gas gangrene—*B. Welchii* or *B. perfringens*. In the case of these products, however, it is customary for manufacturers to control all of their own tests by forwarding samples to the central testing laboratory for the making of comparative determinations. We are indebted to Miss I. A. Bengston for the standard in the case of each of these anaerobes.

Finally, under this head it may be stated that we are endeavoring to establish an antitoxic unit for antidysenteric serum, but thus far the work has scarcely gone beyond the place where we can say that the serum has or has not antitoxic value. Perhaps if bacillary dysentery of the Shiga type were a more serious problem in the United States we might make better progress in this line.

Antibacterial serums: The most important of these is antimeningococcic serum, and it has occupied a large part of our time during the past five or six years. Starting with the simple agglutination test against the various types of meningococci we have gradually extended the work until at present, in addition to this, we often employ the complement fixation test, and even more often the determination of the bacterio-tropins; tests for the latter in this particular connection have been placed on a workable basis by Miss Alice Evans. The protection tests, devised by Gordon a few years ago, were given a fair trial but discontinued as we were unable to get such consistent results as Dr. Gordon seemed to have been able to secure. Indeed, in this case it is not at all clear that protection tests would be of more value than the tests we now employ, since it is possible that the mechanism of protection in animals might be entirely different from the mechanism of therapeutic action in the spinal canal, as the serum is ordinarily employed. Full recognition is of course given to the various types of the organism in all of our tests.

Antipneumococcic serum has been tested at an expense of time and money perhaps unwarranted by the practical utility of the preparation. A mouse protection test, modified from the one originally employed by Neufeld and later extensively used by the workers at the Rockefeller Institute, is in constant use and unquestionably gives a fair degree of evidence on which to judge of the value of the preparation, so far as can be determined by animal tests.

Antistreptococcic serum: In connection with this we have to record only failure to accomplish anything beyond tests which show streptococci have been employed in immunization of horses, and that the resulting serum is protective against small doses of the homologous organism.

It is an interesting fact that this serum, which is on such an unsatisfactory basis from a scientific point of view, is very extensively employed by clinicians, perhaps more extensively than any of the other antibacterial serums.

Antianthrax serum: This serum is not extensively employed in human medicine, but it has occupied the efforts of several of our workers and we are hopeful that satisfactory protection tests may be adopted in the near future. Our work so far has clearly shown the futility of strictly test-tube immunological examinations.

BACTERIAL VACCINES

In connection with this group of rather extensively used preparations, we are again confronted with the question as to whether the value of the preparations is such as to warrant the time and money spent on the efforts at standardization, beyond those necessary to establish tests to assure the safety of the product, since time and money are not available adequately to control all preparations coming under the law and regulations.

Another question, which may fairly be raised in connection with preparations falling into this as well as into some other groups, is whether or not it is possible that the standardization of preparations of dubious prophylactic and therapeutic activity may give rise to a fictitious and wholly unwarranted confidence in the preparations. An exception must be made to this generalization, and this of course is with reference to antityphoid vaccine, the proven worth of which has made it necessary to adopt a standard test on its agglutinogenic qualities, a criterion which we realize is not satisfactory, although it is the best we have.

TOXINS AND SIMILAR PREPARATIONS

We consider here diphtheria toxin for the Schick test. Standardization is based on the Minimal Lethal Dose, and to meet the common practice of the day provides for dosages of one fiftieth and one fortieth of the guinea pig minimal lethal dose as the human dose.

Toxin-antitoxin mixture: The mixture is tested for toxicity, both as to its ability to cause death to the test animals within the usual period of four days and its ability to produce paralysis and later death.

POLLEN EXTRACTS

Pollen extracts are on a most unsatisfactory basis and we are now working on serological tests, controlled by clinical observation, in the hope that one may be adopted or developed which may serve as an index to the desensitizing value of the preparation.

TUBERCULIN

This is still another of the preparations which have occupied more of our time and thought than is warranted by their importance from a therapeutic or prophylactic point of view. We are unable to report any successful outcome of the work which has been devoted to this preparation.

VIRUSES

The most important of these is smallpox vaccine, and there is now actually in use at the hygienic laboratory a method (not original with us) which, by the inoculation of rabbits with a series of dilutions of commercial vaccine, enables us to form a rough estimate of the potency of the material. This particular preparation is so susceptible to external influences, particularly to the temperature at which it is kept, that a potency test satisfactory to-day gives no indication whatever of the efficiency of the material a few days later, if it has been kept under conditions unfavorable to the preservation of the virus.

ANTIRABIC VIRUS

The several modifications of the classical Pasteur treatment, which itself is still in use, have all been examined sufficiently to lead us to believe that the various preparations will, when properly used, serve to prevent the development of rabies when applied sufficiently early.

From this hasty survey you will see that the immunological art is very extensively applied in the control of biologic products and that there are ample fields of investigation in this line which, when sufficiently worked, will enable us to place all of the preparations which are of value on a sounder basis than we have for many of them at the present time.

G. W. McCoy

Hygienic Laboratory,
U. S. Health Service

SOME MODERN PROBLEMS IN LEATHER CHEMISTRY[1, 2]

When the literature of leather chemistry of twenty-five years ago is compared with the publications of to-day, one is impressed by the extraordinary progress that has been made in a quarter of a century. The striking feature of the newer papers lies not so much in the results of technical and practical use, although such are to be noted, but first and foremost in the entirely different point of view in the choice and treatment of the problems. The pioneers in leather chemistry, among whom I would especially mention W. Eitner in this connection, have collectively produced a lot of valuable experimental data which they worked up solely from the standpoint of direct practical application. They have opened up an exceedingly fruitful field of experimentation, also quite naturally utilizing contemporary

---

[1] Translated from German by A. W. Thomas.

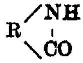
[2] Presented before the Leather Division at the sixty-fourth meeting of the American Chemical Society, Pittsburgh, Pennsylvania, September 4 to 9, 1922.

scientific knowledge. Activity in pure research, however, for the purpose of enlightenment and explanation, entirely unfettered by any thought of practical application, in which the complete structure of modern science is employed, has evidenced itself in the field of leather chemistry only within the past decade. One name joins these two phases of the development of leather chemistry like a bridge—H. R. Procter, who has given us in his "Principles of Leather Manufacture" a large number of very valuable conclusions based on experimental observations, and whose studies on the swelling of gelatin bear the character of the purest scientific research.

How the example set by Procter is being felt by the younger generation and how they are successfully progressing on the road of pure investigation is especially evident in the United States. Such a lively interest in purely scientific studies was unheard of in this field in the past century.

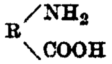
I may be permitted to touch upon a few of the problems which are considered of timely interest by modern scientific leather chemists and to contribute a few remarks to the discussion of these questions which will undoubtedly be brought out in their September, 1922, meeting. My selection in this connection is—our conceptions on the chemical nature of collagen, the mechanism of bating, and what we call the astringency of vegetable tannins.

Concerning the constitution of collagen we know merely what the study of hydrolysis has taught us. From hydrolysis we have a quite exact knowledge of the ultimate split products, the amino acids, but we are only very incompletely informed concerning the nature of their participation in the construction of the collagen molecule. We are indeed justified in assuming that in the main the amino acids are bound together in a peptid-like manner; but this leads us only so far as the peptones, *i. e.*, to those large building stones of which the collagen complex is constructed. We know practically nothing about the manner in which the peptones are bound together. It appears certain that their linkages are fundamentally different from those of the amino acids within the peptone molecule, since pure proteolytic enzymes which cannot effect any decomposition of peptide groups (*e. g.*, pepsin), can break proteins down only to the peptone stage. It is possible that the peptones are combined in a special fashion, which while resistant to peptolytic enzymes (*e. g.*, Erepsin) is vulnerable to the attack of proteolytic enzymes (pepsin). Up to date nothing definite is known concerning the nature of such combination. Plimmer's supposition that it is a question of anhydride-like groupings of amino acids is unproven, and the alternative conception of J. A. Wilson[3] that collagen and gelatin can be represented by the formulas



$$\mathrm{R}\left\langle\begin{matrix}\mathrm{NH}\\ |\\ \mathrm{CO}\end{matrix}\right.$$

and



$$\mathrm{R}\left\langle\begin{matrix}\mathrm{NH_2}\\ \mathrm{COOH}\end{matrix}\right.$$

respectively, is not very convincing, since it is difficult to see why the -NH-CO- groups in collagen hydrolyzable by pepsin should not be attacked by trypsin, while in other respects the behavior of the peptid groups is just the reverse.

If the peptone linkage is assumed to be through primary valences, then we are forced to seize upon a kind of linkage entirely different from the peptide groupings, and concerning which, as previously mentioned, nothing is exactly known up to the present. It is possible, however, that the nature of the connections between peptones within the protein molecule is not at all through groupings which depend upon the saturation of primary valences, but that it consists of much looser bonds in which the peptones play an independent rôle. It is conceivable that this loose connection between the peptones becomes more tenuous during swelling of hide perhaps due to the enlargement of the watery envelopes existing around each single peptone molecule. Accordingly it is clear that swelling could be regarded as a preliminary stage in the peptonizing (*i. e.*, decomposition into peptones). It is also plain to be seen according to such a conception that the skin of young animals, rich in water, would be more easily transformed to gelatin than the hide of older animals, and further that the process of liming would become

[3] *J. Am. Leather Chem. Asso.*, (1917), 12, 108.

more difficult to carry out or even be frustrated in purpose upon dehydration (with alcohol) or by drastic desiccation. There are many examples illustrating the point that gel substances are the more readily peptized, the larger the watery envelopes about the single particles and thereby the greater the distance between them. In collagen the peptones may play the rôle of the individual particles, bound together by weaker valence forces than is wont in the case of primary valence. Just what this kind of affinity will be called remains to be seen. In any case, for the purpose of a preliminary working hypothesis, the following assumption may be of service: Peptones are bound to each other and to other smaller complexes in a loose manner, and are somewhat more strongly separated from other similar peptone complexes by larger water shells. During swelling of the protein these loose bonds can become still more tenuous.

The question now arises as to what influence swelling of collagen exerts on the action of enzymes, where the swelling is caused only by neutral salt solutions, and not by acids nor alkalies, in order to exclude the possibility of hydrolyzing action, *i. e.*, splitting of peptide linkages, by H^+ or OH^- ions. Experiments carried out in the Institute of Leather Chemistry at Darmstadt, and which will be reported elsewhere, have shown that the action of trypsin on collagen (white hide powder) depends to a high degree upon preliminary swelling in neutral salt solutions. The following results are especially noteworthy. If collagen is strongly swollen in normal KCNS or KI solutions, trypsin will almost completely dissolve it. It does not matter whether the trypsin has been added with the swelling salt or afterward. This tryptic action is predominately proteolytic, *i. e.*, it converts the protein predominately to peptones or peptone complexes and splits these into amino acids only to a relatively slight degree, which is shown by the fact that the hydrolysis products in the solution give copious precipitates with tannin, while formol titration yields smaller values than in the absence of the swelling salts. It appears then that the decomposition goes only to the peptone or peptone-complex stage and that the peptolytic action of the trypsin is prevented by the salt present. It is further worthy of note that very concentrated solutions of thiocyanates (5 to 8 N) and of iodides (3 N) have an inhibiting effect on the proteolytic as well as on the peptolytic action of the trypsin, and an astringent or shrinking action of the salt solutions runs parallel thereto.

Experiments with chlorates, nitrates, chlorides and sulfates have shown that these salts bring about swelling, decreasing in effect in the order named, and their influence on the action of trypsin is parallel to the decreasing swelling. Experiments were performed where pieces of pelt were treated with trypsin in N/2 solutions of the various salts at 37° C. The trypsin acted most vigorously upon the pelt, in the presence of thiocyanates, and the activities of the other salts followed at considerable intervals in the order iodides, chlorates and nitrates, chlorides and sulfates; the same order that obtained for the swelling power in the absence of trypsin. The effect is scarcely noticeable with chlorides, and in the case of sulfates it is doubtful whether the effect is null or even slightly negative, *i. e.*, whether sulfates exert a weakly inhibitory effect on the proteolytic action of trypsin.

I wish to especially emphasize the fact that the comparative experiments were all undertaken at the same hydrogen ion concentration (electrometrically measured). It is evident that it is not correct to explain the swelling power of an electrolyte solution solely and entirely as a function of the hydrogen ion concentration. The anion of the electrolyte exercises a very pronounced influence, and the Hofmeister series are not yet to be relegated to the class of abandoned fallacies.

What further conclusions may be drawn from the above observations?

First and foremost care must be exercised concerning the presence of salts in the bate liquor. The greater the swelling effect of these salts, then the more dangerous the activity of the trypsin, since it can lead to deep-seated peptization and to heavy damage to the hide.

Further, the various, widely differing observations which have been published concerning the effects of enzymes (especially trypsin) on hide can be understood. Different experimenters have obviously used collagen of very different degree of swelling, and consequently obtained discordant results. It is also understood why collagen from different animal hides and tendons, while not showing any distinct analytical variations, have behaved differently in their ease or difficulty of conversion to gelatin.

It is already on record in physiological textbooks that collagen that has been previously treated with hydrochloric acid will be attacked by trypsin. That this effect is not a function of the hydrolyzing action of the acid, but rather due to the increase in the swelling is evident from the analogous action of neutral salts which bring about swelling of the collagen.

A new question which turns up is worthy of consideration, namely, whether the fixation of tannins is increased by the loosening of the peptones in the collagen-complex, that is, whether an increased development of surface is effected in the hide by the swelling with neutral salts, which would be shown by an increase in the amount of tannins capable of being fixed. Such experiments are contemplated.

I might now turn to another question which stands out prominently in the field of leather chemistry; the character of astringency. We combine with the idea of astringency the conception of tanning intensity, but until recently there has been no means at our disposal to determine comparative differences in degree of tanning action between two tanning agents which showed the same "tannin" content.

Wilson and Kern[4] have attempted to accomplish this through the determination of the tanning velocity, based on the assumption that a certain proportionality exists between astringency and speed of adsorption. Another method could be suggested from the viewpoint that a strongly astringent tannin will be taken up by a surface of weak adsorptive forces, while a tannin of low degree of astringency requires a powerfully adsorbing surface. A fractionation of the tanning material takes place according to the astringency in each liquor, since hide already considerably tanned and therefore of low adsorptive power will take up only the most astringent fractions in the strongest liquors, while fresh untanned hide will take up the mildest, least astringent tannins and even "non-tans." To test this view it is merely necessary to prepare hide powder of varying degrees of tannage, taking care that all soluble matters are washed out of the tanned powders. Treatment of different tannin solutions with these hide powders of varying degrees of tannage should yield information regarding the relationship of the astringent to the mildly acting parts present. Such experiments are now in progress in this laboratory and it will soon be seen whether they lead to useful conclusions. This procedure will by no means touch upon the question of the reason for astringency. Very interesting experiments by A. W. Thomas and S. B. Foster[5] were applied to the elucidation of this problem, and the results render it quite conceivable that astringency is a function of the electrical charge of the colloidal tannin particles. Previous to learning of this research I held the view that astringency was connected with the size of particles of the tannin. In order to test this assumption, it would be necessary to study the distribution of particles according to size in various vegetable tanning materials. Such an investigation has been pursued in this laboratory and will be published elsewhere. A few of the results are briefly as follows:

When a tannin solution is fractionally salted out, the first fraction will contain the largest particles, the later fractions, smaller particles, and in the final filtrate there will be the smallest non-precipitable tannin particles. When the separate precipitated fractions are filtered off, redissolved, and their amounts determined, comparable figures are arrived at which disclose the size relationships of the tannin particles in different tannin solutions. In this way large differences with various tanning materials are manifested. For example, an extract of quebracho wood prepared in the laboratory is rich in large and medium tannin particles and relatively poor in the smallest non-precipitable particles. Sumac is entirely different in that the greater part is composed of the smallest particles and very few large and medium particles appear to be present. Thus there is a characteristic picture for each tanning material, that certainly is also influenced by the concentration and the manner of preparation of the respective solutions. The effect of age and non-tans on the size of particles is interesting. No two solutions behave alike upon aging. There are those which undergo a very considerable development in size of particles (*e. g.*, quebracho and mangrove) and others, in which this does not happen (*e. g.*, gallotannin, oak wood and chestnut wood). In any case one is not justified in assuming that no gradual change has taken place when a tan solution remains clear (no separation of ellagic acid or phlobaphenes). A solution may remain clear while undergoing an increase in size of particles which will be manifested in its tanning effect.

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[4] *J. Ind. Eng. Chem.*, 12, (1920), 465.

[5] *J. Ind. Eng. Chem.*, 14 (1922), 191.

The effect of non-tans seems in most cases to be an increase in the degree of dispersion or in an inhibition of flocculation, or, in other words, diminution in particle size. This recalls the observation of Wilson and Kern where the speed of tanning was shown to be greatly reduced by gallic acid and suggests a relation between size of particles and speed of adsorption. All non-tans, however, do not behave alike; sumac non-tans, for example, have rather the opposite effect.

A closer examination of this non-tan question has shown that the sugar-like non-tans exert no influence on the size of the tannin particles, but that the phenol-like bodies (gallic acid type) have a pronounced effect. Gallic acid diminishes the precipitable fractions of chestnut tannin and of gallotannin to about one half. Here again exceptions are encountered, for quebracho and sumac are not markedly affected by gallic acid in respect to salting out.

This fractionation of tannin solutions is purely colloidal (according to particle size), and not purely chemical (according to components of different chemical constitution) as proven by the fact that the Lowenthal factor of all fractions is the same. Only in the case of oak bark, which is known to contain a mixture of tannins, one reacting green with ferric salts, the other blue, did fractional salting out effect a separation, although incomplete, of these components. This separation was evidenced by the regular change of the Lowenthal factors and of formaldehyde precipitation. In this treatment the tannin reacting green with ferric ion proved to be of higher dispersity than the blue-reacting tannin.

It yet remained to be tested whether the separate salted-out fractions showed any difference in their other colloidal properties. Viscosity and surface tension were measured with this object in view and compared with the corresponding values of the original tannin solutions. No direct relation between size of particles and viscosity was found, but the surface tension figures did prove to be dependent upon particle size. The first fractions (largest particles) always lowered the surface tension of water to the greatest extent, the decrement decreasing with each further fraction.

The increase in size of particles which ensues if the addition of sodium chloride is maintained under the critical precipitation concentration can likewise be explained as due to lowering of the surface tension. Further, aged tannin solutions also show increased lowering of the surface tension corresponding to increase in size of the particles, with the exception of quebracho. Conversely, there is a distinct correspondence with the fact that all processes or effects tending to decrease the size of particles have the expected effect on the surface tension. Among other things we might mention the diminution of size of particles through short heating of tannin solution, and the especially high degree of dispersion possessed by tannins set free from their lead salts by hydrogen sulfide.

This scanty summary of a few experimental results shows what a fruitful field for colloid-chemical result is offered by our vegetable tanning materials and it is to be expected that many points of practical application will be found when greater light is thrown upon the understanding of the problem of astringency.

The ultimate aim, however, in this and in all other leather chemistry researches is the widening and deepening of our fundamental knowledge of an as yet very undeveloped field.

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ON THE SPECTRAL CHARACTERISTICS OF PROTECTIVE COLORATION

THE following note is of the nature of a preliminary report on some investigations made last summer at Woods Hole. In this investigation an answer was sought to the following specific question: Is the color of a protectively colored animal spectrally similar or dissimilar to the color of the background which it matches?

The significance of the question lies in the light it can throw on the nature of color vision in animals. Take, for instance, the color of the frog—his head and back so closely resembling the slime of stagnant pools that it is difficult to detect him. If, in the first place, this color is adaptive, if the resemblance really helps to conceal the frog either from prey or enemies; and if in addition it can be shown that the frog's green and the green of the slime are, spectrally considered, different mixtures, it follows that the organisms from which the frog is concealed have color vision which in this respect at least agrees with our own. Color, as a natural fact, is not a physical but a psychological entity and a knowledge of facts like this is a knowledge of the *experience* of other organisms. There are those among biologists who deny the existence of adaptations in the sense of directed evolutionary responses by an organism to an environment. It is perhaps not out of place to note that such a denial is here beside the point. All that is really postulated in the case of the frog is that green frogs are safer from enemies or more dangerous to their prey than red frogs would be, so that while the language here implies a particular point of view the conclusions are largely independent of the biological philosophy which may have directed the work.

One obvious difficulty presents itself. We may be confident that cases of adaptive coloring exist but it is difficult to establish the adaptive nature of any particular case. Undoubtedly some cases of close color resemblance are accidental, in the sense of being unrelated to the external life of the organisms, so that it is only by multiplying instances that any general probability can be established. Again, while material of a general sort is available in large quantity, the number of clear cut types is much smaller. The exclusion of material rests upon various grounds, among which may be mentioned:

(*a*) The adaptation is to a very generalized background, and is usually accomplished by similarity of *pattern* as much as by hue. Thus the plumage of the quail and the markings of the garter snake serve admirably to conceal them in natural surroundings, but it is hard to pick out a pair of specific color matches. These cases, which are very numerous, can now be studied in the light of the knowledge of camouflage obtained during the war and some work of this kind has, I believe, been done. This work, which requires special training of the kind possessed by painters, seems capable of yielding very valuable information, but the results would be pertinent to the present inquiry only in so far as they might help to establish more generally the fact of the existence of color adaptations.

(*b*) The pair of colors is such as to offer little variety of possible composition. Reds and blues cannot be synthetized in as many ways as greens and yellows, so that the matches of these colors will necessarily show only minute spectral differences.

From this it follows that the most suitable material is furnished by color matches with a solid green or yellow background. The cases which were found most suitable were those of animals colored green to match the leaves and grass in which they lived. Such cases are very numerous among reptiles and insects and are particularly good instances because the green of chlorophyll has well marked spectral characteristics, being relatively deficient in the blue-green. On the other hand, many green insects assimilate directly in the epidermis the chlorophyll of the leaves on which they feed. Thus the katydid and the tomato worm are colored with actual chlorophyll. For such cases there would necessarily be no spectral difference and there is moreover not the same presumptive evidence of color adaptation. There remain, however, a large number of instances of which a few were studied.

The method of study adopted was by the use of color filters. These were used either (1) by illuminating the animal on its background with white light and viewing through the filter; or (2) by illuminating with the light transmitted through filter. For the cases studied the two methods are equivalent, the first being suited to the study of organisms in their out of doors environment, and the second being on the whole more convenient in the laboratory. The two methods are not in all cases equivalent, as will be noted later.

The filters used were an improvised set made by fixing out and washing ordinary photographic plates and dipping them in dyes. These were made before going to Woods Hole and all dyes of the rather meagre stock available were tried out. These included some pre-war specimens of commercial "Diamond Dyes" and it is perhaps unfortunate that some of the most useful filters were made from these dyes of unknown composition. The most important filter is, however, Brilliant Green (Gruebler). Used in combination with Diamond Orange this transmits deep red and the blue end of the green. Seen through this combination foliage appears brownish red, whereas most artificial green pigments appear more intensely green. Used with Diamond Turkey Red the same general effect is produced, the obliterated portions of the spectrum being somewhat wider so that the greens appear bluer and the reds purer. Used with Diamond Olive Green, foliage appears straw color. Brilliant Green and eosin transmits only red and blue.

The most characteristic phenomena are shown by the common grass snake (*Liopeltis Vernalis*). The use of this animal, a specimen of which was secured early in the investigation, was suggested by the late Dr. George Lefevre, and saved much time which might otherwise have been spent in search for suitable material. This is to the eye so good a match for the grass which it inhabits that it is hard to discover the snake even when the observer is looking directly at it. When viewed through any of the filter combinations mentioned above the contrast is vivid and startling. The snake appears a vivid green, or, in the case of the eosin combination, deep blue—in absolute contrast to the red or yellow grass. A photograph, which can not here be reproduced, exhibits this contrast, the panchromatic plates used being more sensitive to the red than to the green, so that the snake appears darker; but no photograph can reproduce the violence of the color contrast. The green of frogs is of a similar character. Certain grasshoppers (*e.g. Melanoplus femur-rubrum*) have in their coloring a green that is spectrally different from leaf and grass greens, also the green of the so-called Florida chameleon (*Anolis Carolinensis*). This last changes from green to brown, but the coloring is not clearly adaptive.

These scattering observations and a few others were all that the time permitted last summer. While not sufficient to warrant definite conclusions they indicate clearly that color vision similar to human exists lower in the phylogenetic scale. It is hoped that next summer will furnish instances sufficiently numerous to settle this point definitely. In addition, many interesting lines of development open up, some of which will now be indicated.

Color is, as remarked above, not a physical but a psychological entity. To be green is to appear green to some percipient and it is the visual experience of this percipient that alone can explain the color in the sense in which we here use the word "explain". To make this sense clear it may be noted that though we may or may not have an explanation of the absorption spectrum of chlorophyll or hemoglobin, such an explanation would not touch the problem of the greenness of grass or the redness of blood. This being understood, the question arises: For what percipients does the color of a given organism exist? Now according as it can be shown to exist for the organism itself or for its environmental enemies or prey, we are led to biological implications of quite different kinds. In the first case we would be led to consider the evolutionary development of the adaptation as guided from without by natural selection or some similar process, whereas in the second case we are led to think of an evolutionary process self contained within the organism. These two points of view divide evolutionary speculation into two classes which we may call the peripheral and central types and the class of facts which these investigations open up seems suited to throw light on this very fundamental question. Keeping this philosophical problem in mind, let us enumerate some definite questions of fact which need to be settled.

(1) Just how low in the scale of organisms does color vision exist? The snakes and lizards have vertebrate enemies from which protection is needed. Most insects have birds to fear, so

that the few instances here studied give information only about the vertebrate eye. Cases of coloration among marine organisms are known which indicate color vision in anthropods, and the current explanation of the colors of flowers presupposes an ability of insects to discriminate color, but more information on this point is needed.

(2) Some animals have variable color and some at least of these make their own color response to visual stimuli. The most conspicuous example is the flat-fish. The very thorough studies of Mast and others establish the fact that this sees color, but no tests have been made to see whether, for instance, a red-green combination would be matched by its subjective equivalent, yellow. Here we have an animal which can actually be put through the same kind of psychological test that is applied to men. We ask it in effect, "What does this look like to you?" and tests can be made for after-image colors, contrast illusions, etc. Such tests seem likely to throw more light on color vision in animals than any other line that is now open. In this connection a point of technique in the use of color filters should be noted. It was said above that it is a matter of indifference whether the grass snake is illuminated with white light and viewed through the filter, or illuminated with the filtered light. This is true for an animal of fixed color, but it will be readily seen that the experience of the snake is different in the two cases, for in the second case it shares with the observer the color contrast produced. As a matter of fact the snake manifested no uneasiness at being thus rendered so startlingly conspicuous, indicating that color experience does not form a part of his ordinary response, though this can hardly be affirmed definitely on the basis of a single uncontrolled observation. In the case of an animal like the flat-fish, however, it is clear that the two methods of observation would lead to quite different results, for in the second case the fish would respond so as to make the contrast disappear as far as possible.

(3) Does color perception imply color *vision, i.e.*, are eyes essential to the process of color response? The question may seem absurd, but cases are cited in the literature of larvae forming chrysalides matching a background in which blinding the larvae did not alter the response. It may be that the underlying photochemical processes are here generalized in the skin instead of being confined to a specific end-organ. This would place color response on the same footing with most others, but the present meagre indications of fact must be widely corroborated and extended before any conclusions can be drawn.

(4) Do animals with dichromatic color vision exist? Is, for instance, the brilliant plumage of the cardinal really a contrast to the surrounding foliage for the eyes that are most concerned with finding him?

The writer hopes during the next and succeeding summers to continue work on some of the problems here raised.

This work was rendered possible by the generosity of the Nela Research Laboratories of the General Electric Company, who defrayed the expenses of the work at Woods Hole. To a physicist venturing into foreign fields the biologists there were most generous in their advice and encouragement. To Dr. Ralph S. Lillie in particular my thanks are due for his unfailing interest and helpful suggestions.

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FEBRUARY 28, 1923

LONGEVITY IN THE SOUTHERN STATES

THE federal statistics of 1920 are very important because they afford the first satisfactory opportunity of estimating longevity in the southern states. It is true that southern states were added to the registration area for deaths a few years before 1920, but as population statistics are collected only at decennial intervals the year 1920 is the first year at which both mortality and population statistics of the southern states are directly available.

As the negro has so often been referred to as the most disturbing factor in the progress of this country the results of an investigation into the relative longevity of southern states whose populations include such large numbers of negroes should be of considerable interest and importance. The writer believes that the general feeling among those interested in the problem has been similar to his own that such results would prove alarming. If so, the results of this paper will prove quite surprising, for if the statistics of these southern states are reliable longevity in the south compares very favorably with longevity in the north. Those of us who have felt considerable pride in comparing longevity in this country with longevity in other countries have always felt a mental reservation on account of the possible conditions in the south since the latter were never represented in the comparison. It affords great relief then to find evidence that longevity in the southern states with their large proportions of negro population not only compares favorably with longevity in the northern states but even excels in some cases; that is, longevity in some of the southern states seems to excel quite significantly the longevity in some of the northern states. The writer hastens to add, however, that in his own estimation these conclusions are affected somewhat by consistent overstatements of advanced ages, at least, in most of the southern states. While it is impossible, of course, to measure the extent and effect of this tendency its existence is beyond question as is evidenced by the unnatural "bunching" of data in both the mortality statistics and the population statistics at the highest ages. However, the method followed in this investigation is one which minimizes inaccuracies at the most advanced ages, and considering that the first numerical measures of any natural phenomenon can be regarded only as first approximations the writer believes the numerical results given below to be very satisfactory for purposes of comparison with results obtained from other populations and drawing general conclusions therefrom.

The numerical results of this paper were ob-

MALES—EXPECTATION OF LIFE

Age	Ky.	Tenn.	Miss.	No. Car.	Va.	Florida	La.	So. Car.
10	54.2	52.5	51.0	52.1	51.8	50.1	50.0	49.5
20	46.1	44.6	44.5	43.9	43.7	42.3	42.1	41.6
30	38.5	37.4	37.7	36.7	36.3	35.2	34.9	34.6
40	30.7	30.2	30.4	29.5	29.0	28.2	27.9	27.8
50	23.0	22.9	22.9	22.2	21.8	21.5	20.9	20.7
60	15.9	16.0	15.8	15.3	15.0	15.2	14.8	14.2
70	10.1	10.3	9.9	9.4	9.4	9.8	9.6	8.9
80	5.8	6.0	5.8	5.4	5.5	5.6	5.6	5.3
Ave. Exp.	32.90	32.47	32.23	32.08	31.90	31.40	31.28	30.98

DEATH RATES PER 10,000

10	27	26	30	24	24	30	30	28
20	51	59	73	55	56	66	62	67
30	58	77	77	82	75	82	85	95
40	73	93	80	89	92	115	101	102
50	104	116	115	127	131	160	164	151
60	219	224	212	222	253	267	294	286
70	504	486	496	532	549	529	559	594
80	1086	1070	1202	1296	1312	1121	1153	1438

FEMALES—EXPECTATION OF LIFE

Age	Ky.	Tenn.	Florida	La.	Miss.	Va.	No. Car.	So. Car.
10	53.0	51.2	51.2	50.6	49.7	50.2	50.3	48.3
20	45.0	43.5	43.2	42.5	42.3	42.3	42.3	40.6
30	37.8	36.8	36.2	35.6	35.8	35.4	35.4	34.2
40	30.7	30.1	29.4	29.0	29.3	28.6	28.8	27.9
50	23.1	23.1	22.6	22.2	22.6	21.7	22.0	21.4
60	16.1	16.3	15.9	15.7	16.0	15.3	15.1	15.1
70	10.3	10.5	10.2	10.2	10.2	10.0	9.2	9.9
80	6.0	6.2	6.0	6.1	6.0	5.9	5.4	6.6
Ave. Exp.	32.68	32.20	31.97	31.72	31.68	31.50	31.48	30.98

DEATH RATES PER 1,000

10	26	28	25	25	33	27	23	29
20	58	69	64	63	78	66	65	80
30	83	97	89	97	108	94	98	112
40	80	100	107	108	110	107	116	127
50	111	132	138	152	149	147	127	160
60	219	210	226	256	219	270	234	270
70	475	475	502	500	489	517	521	564
80	1083	1063	1075	1098	1101	1128	1474	1237

tained by constructing abridged mortality tables from the mortality and the population statistics of 1920 of each of the eight southern states, Kentucky, Tennessee, Mississippi, North Carolina, Virginia, Florida, Louisiana and South Carolina for both the males and the females. Tables were constructed for both sexes also for the eight states taken as a whole and likewise for the ten northern states Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont. Twenty abridged mortality tables then were constructed. The mortality tables themselves are not given, as practically nothing can be deduced from them which can not be deduced from the tables of expectations of life and death rates on the preceding page.

It will be noticed that the records of the various states vary in different ways at different ages; that is, one state may show up better at one interval of ages and another state at another interval. For that reason it is not easy to arrange the states according to their proper standing, as was attempted here. The scheme followed here was to compute what might be called the *average* expectation of life which is merely the average of the expectations of life at the given ages weighted by the number living at those ages as given by the abridged mortality table.

No detailed discussion of the expectations of life and the death rates at the different ages for the different states seems necessary. It is interesting to note, however, the excellent results of Kentucky and Tennessee, particularly Kentucky. Several years ago, the writer investigated the longevity of native Americans of native parentage and expressed then his belief that their record of longevity would compare favorably with the longevity of any other nationality. Measures of that longevity are closely approximated by the expectations of life for Kentucky. As the expectation of life at age 10 closely approximates that at age of birth in most mortality tables the expectation of 54.2 years for the males and 53.0 years for the females might be regarded as approximations of the average span of life of the two sexes in that state. It should be noticed that longevity in Kentucky seems to excel the average results for the ten northern states (see below) to a considerable extent. It is very remarkable that the records of the males seem to excel those of the females in five of the eight southern states (*i. e.*, in Kentucky, Tennessee, Mississippi, North Carolina and Virginia).

It is interesting to compare the expectations of life and the death rates of the ten northern states and of the eight southern states.

EXPECTATION OF LIFE

	MALES		FEMALES	
	North	South	North	South
10	52.3	51.7	52.9	50.7
20	44.0	43.8	44.6	42.9
30	36.1	36.5	36.9	36.1
40	28.4	29.3	29.3	29.4
50	21.0	22.1	21.8	22.4
60	14.3	15.8	14.9	15.7
70	9.0	9.8	9.5	10.1
80	5.2	5.7	5.5	6.0
Ave. Exp.	31.76	32.00	32.17	31.85

DEATH RATES PER 10,000

	MALES		FEMALES	
	North	South	North	South
10	30	27	26	27
20	45	60	46	67
30	62	77	69	96
40	83	92	81	106
50	132	130	122	132
60	281	246	249	237
70	604	526	568	502
80	1332	1191	1225	1124

It will be noticed that the expectation of life of the males of the northern states excel those of the males of the southern states only at ages 10 to 20 and that the average expectation of life of the southern males exceeds that of the northern males. It is a very interesting question to what extent the indicated superiority of the southern males at ages 30 and beyond is due to overstatement of ages. With the very worst interpretation comparison of the death rates of the two groups shows that the south compares very favorably with the north. The females of the two groups compare much the same way but the beginning of the indicated superiority of the southern females appears at a later decennial age than in the case of the males and hence the northern females show a slightly greater average expectation of life. It should be noticed that the southern males excel the southern females in the average expectation and in the expectation of life and death rates at the earlier ages. Again it would be interesting to know whether and to what extent the indicated superiority of the southern females at the advanced ages is due to overstatement of advanced ages.

It should be stated that no scheme of smoothing of data was employed in computing the death rates given in the tables above and that the computation of each death rate was essentially independent of that of any other. In the light of this fact the absence of significant incongruities and the general agreement of the various numerical results at the different ages of all twenty mortality tables is rather remarkable. It is only hoped that the evidences of overstatement of advanced ages—and the northern states are not wholly beyond criticism in this respect—will gradually disappear. It should also be added that since all of these mortality tables were constructed from the statistics of a single year (1920) the results given above are offered merely for purposes of comparison and *general* conclusions.

C. H. FORSYTH

DARTMOUTH COLLEGE

SCIENTIFIC EVENTS

SAFETY CODE FOR AUTOMOBILE BRAKES

A NATIONAL safety code for automobile brakes and brake testing will be developed under the auspices of the American Engineering Standards Committee as the result of the decision of a special committee consisting of representatives of the American Automobile Association, the Motor Vehicle Conference Committee, the Conference of Motor Vehicle Administrators, the American Society of Mechanical Engineers, the United States Bureau of Standards, the United States War Department, the Society of Automotive Engineers, the Underwriters Laboratories, the Safety Group of the American Engineering Standards Committee and David Beecroft of the Class Journal Company. David Van Schaack, vice-president of the National Safety Council, was chairman of the committee.

The American Engineering Standards Committee has asked the Society of Automotive Engineers, the Bureau of Standards and the American Automobile Association to act as joint sponsors for the development of this code. The actual work of formulating the code will be carried on by a sectional committee representative of all the interests concerned with the problems of automobile brakes either as administrative officers, users, producers or general public.

The need for a national safety code covering methods of testing brakes and also those elements of brake or brake lining construction which are accident factors is emphasized by the increasing tendency toward state and municipal legislation on this subject. Several states already have brake testing laws and in a number of other states such laws are being drafted. There is, however, no agreement at present as to what is a safe braking distance or what constitutes a satisfactory braking test. Until a national safety code has been developed and generally accepted the motorist driving from one city to another or from state to state will have no assurance that brakes approved in one city will not bring a fine in the next town or state.

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

THE Australian National Research Council has issued a report of its annual meeting held in Sydney in August last which is summarized in *Nature*. The council was formed for national and international purposes in January 1921 by the Australian Association for the Advancement of Science, to which body it has to submit a full report of its work and proceedings on the occasion of each meeting of the Association. At the meeting Sir David Orme Masson was elected president of the council in succession to Sir Edgeworth David. Resolutions were passed urging the need for the State endowment of systematic research in the Pacific islands under Australian control, for research work in Australia in respect of refrigeration, and for laboratories to carry out industrial investigation and research. Offers of co-operation with the Commonwealth Institute of Science and Industry in measures for furthering these objects were made, and preliminary steps taken for the inauguration of a publicity campaign for the purpose of securing that the functions, operations and financial needs of the

Institute may be more fully appreciated by the Commonwealth Government, the Legislature and the public generally. The council has decided to ask the Australian Association to regard it as a fully constituted body free to conduct its own affairs subject to instructions from the International Research Council. The first issue of *Australian Science Abstracts,* published by the Australian Research Council as a quarterly journal of abstracts of papers by Australian scientific workers, appeared on August 1, 1922. An invitation has been issued by the Commonwealth Government through the Research Council to the representatives of the Pan-Pacific Scientific Congress to hold the Congress in Australia in 1923.

ENGINEERING LIBRARY FOR DENVER

Scientific circles will recognize the importance of the library facilities that have just been opened for engineers and scientific men in the City of Denver.

The Colorado Scientific Society has had a long history and has been the medium through which many discoveries, especially along the line of geology and mineralogy, have been announced. In the past few years this organization has not been as active and its financial means have not enabled it to carry on work to the same degree as formerly.

It has been given quarters for a number of years by the State of Colorado in the State Museum Building, and many of its museum specimens have been cared for by the State Bureau of Mines. Through exchanges and through purchase and through gifts from members, it had acquired a library especially valuable in transactions of learned societies, in scientific exchanges and in engineering books.

The engineers and men of applied science felt the increased need of a library for reference. There is no important library of this kind available for practically a thousand miles. The Rocky Mountain region has a large number of different lines of science represented by men of ability, but has lacked these facilities.

The various engineering societies, especially the twelve which are grouped together and form the Colorado Engineering Council, have been active in pushing the idea of the union of forces and starting a library of this character.

The State of Colorado passed a few years since a law requiring all practicing engineers to register and pay a license fee. The funds from this source have amounted to some $15,000. The cooperation of this board was obtained and these funds made available for the purchase of books, which could be done under State laws, and the books used in connection with the books of the Scientific Society and other books, the title remaining in the State.

The Society of Architects which had a fund of some thousands of dollars, has made their fund available for this technical library. Many books have been given by individual engineers who find it unnecessary to keep in their private collections so many works if they are available to them at any time in a library.

The Denver City Library has assigned room and a technical librarian and takes supervision and general charge of the collection.

The dedication exercises were held on April 7, with representatives from the Scientific Society, engineering professions, city of Denver and the State of Colorado.

This library has some thousands of volumes to start with, and an assured income of several thousand dollars. The prospect is that this will be the most important center for a technical library and applied science between Chicago and the Pacific Coast.

L. G. Carpenter, *President.*
Colorado Engineering Council.

NEW YORK BOTANICAL GARDEN LECTURES

During the spring and summer lectures are being given on Saturdays and Sundays at 4 p. m. in the lecture hall of the Museum Building as follows:

April 28. "Spring wild flowers," Dr. G. C. Fisher.

April 29. "Pasteur and the founding of bacteriology," Dr. G. M. Reed.

May 5. "Books on gardening," Dr. J. H. Barnhart.

May 6. "Bees and bee culture," Professor G. C. Norton.

May 12. Nature talks—II. "Rocks," Dr. W. A. Murrill. (Exhibition of spring flowers, May 12 and 13).

May 13. "Daffodils and tulips," Mr. K. R. Boynton.

May 19. "Practical hints on garden design," Miss E. L. Lee.

May 20. Nature talks—III. "Soil," Dr. W. A. Murrill.

May 26. "The tea gardens of Ceylon and Japan," Dr. H. A. Gleason.

May 27. "Wild flowers," Mr. L. W. Brownell.

June 2. "Economic uses and possibilities of seaweeds," Dr. M. A. Howe.

June 3. "Evolution," Dr. C. S. Gager.

June 9. "Insects and insect fungi," Dr. F. J. Seaver.

June 10. Nature talks—IV. "Ferns," Dr. W. A. Murrill.

June 16. "Summer wild flowers," Mr. C. W. Johnson.

June 17. "Roses," Mr. Robert Pyle.

June 23. "The big trees of California," Dr. H. A. Gleason.

June 24. "The history and sources of quinine," Dr. H. H. Rusby.

June 30. "Flowers of the four seasons," Mr. K. R. Boynton.

July 1. Nature talks—V. "Mushrooms," Dr. W. A. Murrill.

July 7. "Plant traps," Dr. J. H. Barnhart.

July 8. "Some great men and their love of trees," Mr. Carl Bannwart.

July 14. "Diatoms—plants of beauty seen through a microscope," Dr. M. A. Howe.

July 15. "A garden pilgrimage in England," Mr. Montague Free.

July 21. "Collecting fungi in Porto Rico," Dr. F. J. Seaver.

July 22. Nature talks—VI. "Punk-fungi," Dr. W. A. Murrill.

July 28. "Fifty trees in the botanical garden," Mr. K. R. Boynton.

July 29. "Evergreens: what to plant and where to plant them," Mr. Arthur Herrington.

FORESTRY RESEARCH

AN anonymous donor has given $100,000 to Harvard University and an equal sum to Yale University to establish endowment funds for research work on forestry problems.

The income of the fund offered to Harvard, it is stipulated, is to be used for research and experimental work in forest production, "to determine the basic facts essential to the successful practice of silviculture in the northeastern section of the United States, especially in New England." The Harvard forest, consisting of three tracts of land in Petersham totaling over 2,000 acres, has been maintained for fourteen years under the direction of Professor Richard T. Fisher, to serve as a model forest to demonstrate the practice of forestry, as a field laboratory for students, and also as an experiment station for research. The forest has in operation practicable methods of reproducing and improving forests; it has large plantations under test for varying situations; and it is investigating forestry problems of all sorts. The expectation at Harvard is that the new gift will make it possible to develop this scientific work to a much greater extent than has hitherto been possible, and will thus aid in securing the technical knowledge needed to handle forest crops effectively in the face of an impending national timber shortage.

For several years Yale has owned forests in Connecticut, New Hampshire and Vermont upon which some experiments are already being carried out. The Northeast section of the United States affords the best opportunities for demonstration of the practice of forestry. The best markets are here, and the greatest need of intensive field work.

According to Henry S. Graves, dean of the Yale School of Forestry, and formerly chief of the United States Forest Service, the new gift will make possible a large increase in the field studies in the growth and production of pine on the Keene experimental forest in New Hampshire and of hemlock and hardwoods on the Connecticut properties. Professor James W. Toumey and Professor Ralph C. Hawley will supervise the research work.

SCIENTIFIC NOTES AND NEWS

SIR DAVID BRUCE has been nominated by the council as president of the British Association for the Advancement of Science at its meeting next year in Toronto.

THE National Academy of Sciences has presented its Comstock Prize to Professor William Duane, of Harvard University, in recognition of his researches on X-rays, and its Mary Clark Thompson Gold Medal to Dr. Emmanuel de Margerie, director of the Geological Survey of Alsace and Lorraine.

AT the April stated meeting of the Franklin Institute, held on the eighteenth instant, the Howard N. Potts Gold Medal was presented to Dr. Albert W. Hull of the Research Laboratory, General Electric Company, Schenectady, New

York, for his paper on "The crystal structure of the common elements." At the same meeting the Edward Longstreth medal was presented to the Société Genevoise d'Instruments de Physique of Geneva, Switzerland, for their universal measuring machine. This medal was received by Mr. Roy Y. Ferner, of Washington, D. C., the American representative of the society.

THE Matteucci gold medal, conferred as a posthumous honor by the International Research Council at Brussels in 1919 on the late Mr. H. G. Moseley, of Trinity College, Oxford, has been delivered to his mother.

WORD has been received from Holland that Dr. L. O. Howard, of Washington, has been made honorary president of the International Conference of Phytopathologists and Economic Entomologists which is to be held June 24th at Wageningen, Holland. While in Europe, Dr. Howard will attend the International Congress of Agriculture at Paris May 22-26, and the international conference concerning *Dacus oleae* to be held at Madrid on June 18.

PROFESSOR CHARLES PALACHE has been appointed curator of the mineralogical museum at Harvard to take office next September, in place of Professor John Eliot Wolff, whose plan to retire from active teaching next summer was recently announced.

DR. CHARLES SCHUCHERT, professor of paleontology and historical geology at Yale University since 1904, and Dr. Horace L. Wells, professor of analytical chemistry and metallurgy since 1893, will retire from active teaching in June.

ACCORDING to an announcement recently issued by the board of conservation and natural resources of the state of Illinois, Dr. Morris M. Leighton has been appointed chief of the State Geological Survey, to succeed Frank W. DeWolf, who resigned on March 20. Dr. Leighton, who is at present associate professor of geology at the University of Illinois, has for several years maintained a part time connection with the Illinois State Survey, carrying on during the summers investigations, both scientific and economic, relating to the surficial deposits of the state.

DR. EDWARD P. HYDE, who organized the Nela Research Laboratories in 1908 and who in recent years has occupied the position of director of research of the National Lamp Works of the General Electric Company, has tendered his resignation to take effect June 30 of this year. Dr. Hyde will take a prolonged rest abroad.

DR. HENRY GORDON GALE, professor of physics and dean of the Ogden Graduate School of Science of the University of Chicago, has been elected a director of the John Crerar Library.

HARRY N. WHITFORD, assistant professor of tropical forestry at Yale University, has been granted leave of absence to assist the United States Department of Commerce in the investigations in the production of rubber recently authorized by Congress.

APPOINTMENT of W. L. Abbott, of Chicago, as chairman of a committee to make a nation-wide coal storage survey in cooperation with the United States Coal Commission and the Department of Commerce is announced by the Federated American Engineering Societies.

DR. FRANK APP has resigned from the Agricultural College and Experiment Station of Rutgers College to become vice-president of the Minch Brothers Company at Bridgeton, N. J.

COLONEL CHARLES KELLER, of the Corps of Engineers, U. S. A., who has served for the past two years as engineer commissioner of the District of Columbia, has resigned to undertake work in connection with hydro-electric development on the Pacific Coast.

PROFESSOR AND MRS. T. D. A. COCKERELL, of the University of Colorado, will sail from San Francisco for Yokohama on June 4. Thence they will proceed to Vladivostok, in order to investigate a deposit of fossil insects recently discovered on the coast of Siberia, returning to America in September.

SIR WALTER BALDWIN SPENCER is about to lead, on behalf of the Australian government, a mission into Central Australia to investigate the best means of improving the conditions of the aborigines.

CAPTAIN ROALD AMUNDSEN left Nome, Alaska, on April 13, by dog team for Wainwright, five hundred miles north, in preparation for an attempt to fly over the North Pole to Norway.

S. R. WILLIAMS, professor of physics of Oberlin College, is spending a year's leave of absence at the California Institute of Technology. At a recent public meeting held in the auditorium of the Norman Bridge Laboratory of Physics, Professor Williams spoke on the subject of "Magnetism" and gave a public demonstration of the Barkhausen effect by means of a power amplifier and a "Magnavox."

DR. ALFRED MARSTON TOZZER, of Harvard University, is in residence at Pomona College until May 10, giving a series of lectures on the Johnson foundation. He will deliver a series of three lectures on anthropology, three lectures on the "Evolution of man" and three popular evening lectures.

DR. T. C. MENDENHALL, of Ravenna, Ohio, delivered the annual address before the Ohio Eta Chapter of Phi Beta Kappa, Ohio Wesleyan University, on April 9. His subject was "Weighing the earth."

PROFESSOR ALBERT A. MICHELSON, of the University of Chicago, will lecture before the Brooklyn Institute of Arts and Sciences, Friday evening, April 27, on "The measurement of stars by light waves."

AT a meeting of the Washington alumni chapter of Phi Kappa Phi on April 11 an address was delivered by Dr. E. W. Allen on "Pasteur: a lesson in productive scholarship".

DR. PAUL S. WELCH, of the University of Michigan, *national president of the Gamma* Alpha Graduate Fraternity, will lecture on April 27 under the auspices of the Ohio chapter on the subject, "Limnological investigations on Michigan lakes."

PROFESSOR LOUIS KAHLENBERG, of the department of chemistry of the University of Wisconsin, was at the University of Missouri at Columbia on April 4 and 5 and at the School of Mines at Rolla on April 5 and 6. He lectured at both places on his experimental researches on the separation of crystalloids by dialysis. He also spoke at convocation on recent tendencies in scientific research.

DR. KAREL FREDERIK WENCKEBACH, professor of medicine, University of Vienna, will deliver the eleventh Harvey Society lecture at the New York Academy of Medicine on Saturday evening, April 28. His subject will be "The rhythms of the heart."

DR. KENNETH C. HEALD, of the United States Geological Survey, geologist in charge of the section of geology of oil and gas fields, is on leave of absence from the Geological Survey, delivering a course of lectures on petroleum geology at the University of Chicago.

AT a joint meeting of the American Association for the Advancement of Science, Sigma Xi and Phi Kappa Phi at the Pennsylvania State College on Friday, April 20, Herman Stabler of the United States Geological Survey spoke on "The canyons of the Colorado River" and Professor J. E. De Camp discussed "The mental tests at State College" which have been given by the department of education and psychology.

IN *accordance with the plan adopted* last year of throwing open to the public a series of lectures on various topics in the field of physics, Harvard University, through its department of physics, has arranged to offer this spring three popular lectures, as follows: April 27, "Sound waves," with experimental illustrations, Professor F. A. Saunders; May 4, "Atomic explosions," Dr. Kemble; May 11, "Electron tubes, amplifiers, detectors and oscillators," Professor E. L. Chaffee. Each of these lectures will be held in the large lecture room of the Jefferson Physical Laboratory and will begin at 8 p. m.

THE Friday evening meetings of the Royal Institution, London, were resumed on April 13, when the discourse was delivered by Dr. W. H. Eccles on "Studies from a wireless laboratory." Succeeding discourses will probably be given by Mr. W. J. S. Lockyer, Mr. C. V. Boys, Professor Soddy, Professor W. A. Bone, Mr. W. M. Mordey, Sir Aston Webb, Professor Lorentz and Miss Joan Evans.

LEGISLATION against teaching "as true" either "Darwinism or any hypothesis that there is blood relationship between man and the animals," was urged by William Jennings Bryan in an address to the West Virginia legislature on April 13.

TWO fellowships, of 12,000 liras each, are offered by the Italian government for research on malaria. Among the themes suggested for special study are the development of malaria in regions with few mosquitoes; the biology of mosquitoes; their range of flight; the incidence of malaria before the mosquito season; relations between malaria and domestic animals; the water plants which promote or check proliferation of mosquitoes; other larvacidal measures and means to enhance immunity and protect workers in the fields.

THE University of Chicago board of trustees announces that the Metropolitan Life Insurance Company has again renewed its grant of $3,000 to the department of hygiene and bacteriology for special investigations in respiratory diseases.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Minnesota has received a gift of $250,000 with which to erect and equip a cancer hospital to be a part of the University of Minnesota General Hospital. The money was donated by the Citizens Aid Society of Minneapolis, established in 1916 by the late George H. Christian.

EIGHT members of the faculty of the Women's Medical College of Philadelphia presented their resignations to the board of incorporators of the institution on April 17 in protest against the dismissal of Dr. Alice W. Tallant, head of the obstetrics department. This made a total of fifteen resignations, including the entire surgical staff, for the same cause. Incompatibility was assigned as the reason for Dr. Tallant's dismissal.

THE resignation of Dr. John P. Sutherland as dean of the Boston University School of Medicine, after twenty-six years of service as the head of the school, has been accepted by the trustees, and Dr. Alexander S. Begg, formerly dean of the Harvard Graduate School of Medicine, now professor of anatomy at the school, has been appointed dean for the coming year.

AT Yale University Adolph Knopf, associate professor of physical geology and petrology, has been promoted to be professor; George E. Nichols, assistant professor of botany, to be associate professor; and Charlton D. Cooksey and Alan T. Waterman, instructors in physics, to be assistant professors.

DR. J. H. VAN VLECK, now at Harvard, and Dr. Gregory Breit, who this year is National Research Council fellow in physics, also at Harvard, have been appointed to assistant professorships at the University of Minnesota department of physics following the resignation of Professor W. F. G. Swann to go to the University of Chicago. Dr. Van Vleck, a son of Professor Van Vleck, of the University of Wisconsin, has worked on atomic structure. Last year Dr. Breit conducted research in physics at the University of Leyden.

MR. R. S. ADAMSON, lecturer in botany at Manchester, has been appointed to the Harry Bolus chair of botany in the University of Cape Town.

DISCUSSION AND CORRESPONDENCE

MARINE ZOOLOGICAL STATIONS

I AM sorry that my recent letter to SCIENCE[1] regarding work in marine zoology seems to have caused Dr. Fisher[2] uneasiness. Perhaps I can try here to indicate more clearly what I had in mind.

A number of the points raised in Dr. Fisher's comment were familiar to me, and do not cause me to change my original view. Perhaps the most important matter involves the proposition that one can not continuously pursue intellectual work in a warm climate, and that the "glamor" fades. My own belief, based upon a certain amount of direct observation, is this: that a person, biologist, who will loaf in (say) Bermuda, will probably loaf in any other place. The notion that all biologists not in the subtropics work continuously and at high intellectual pressure would certainly be grotesque! As Peterson remarks, in speaking of his bottom sampling operations, to carry on research it is necessary not only to have equipment and the opportunity for using it; it is necessary also to have ideas. So that if there were an inevitable incompatibility between warm weather and cerebration, for the majority of persons, it would surely be unfortunate. But aside from Beebe's pronounced expressions of opinion on this subject, I may point to the fact that Dr. Fisher's view, as he has stated it, does a quite unmerited injustice to workers at Manila, in Java, in

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[1] SCIENCE, December 29, 1922, p. 751.

[2] *Ibid*, February 23, 1923, p. 233.

India, in some parts of South Africa, and in Hawaii, and in South Australia.

Apart from all this, the thing which I chiefly strove to emphasize is the fact that a marine laboratory can hardly hope to justify itself as an investment if it relies solely upon the sporadic visits of biologists recuperating from a siege of instructional duty. It seems to me that there is most urgent need for a station, suitably located, which may hope to do the sort of thing which Naples did and which Plymouth is now doing, and in an environment of the most advantageous character. Convenient accessibility is highly desirable. One can hardly speak of Pacific Coast laboratories as "accessible" *for the majority of American biologists*; it is cheaper, or as cheap, to go to the nearer parts of Europe.

But in my letter I spoke of "accessibility" in another sense, with reference to a varied fauna. I have in mind especially the conditions at Bermuda, but I doubt not that other locations equally favorable can be found. Within less than an hour's run in a small boat from the Bermuda laboratory and in most cases closer than this, one could reach exposed or sheltered shores of sandy, muddy, or rocky type, caves, mangrove creeks, lagoons, and the locations of four or more distinct types of coral associations, each with its characteristic fauna, and all of them free from pollution; and this at all periods of the year. I doubt very much if those who have not tasted the experience of continuous biological work (not merely collecting of specimens) under such conditions have a proper realization of its possibilities. The abundance of this fauna can be appreciated only by living with it. It seems to me stupid that the opportunity to further the advancement of biology in locations of this sort has not been seized.

W. J. CROZIER

ZOOLOGICAL LABORATORY,
RUTGERS COLLEGE

A PROGRAM OF OCEANIC INVESTIGATIONS

TO THE EDITOR OF SCIENCE: Like Dr. Fisher (SCIENCE, February 23, 1923, p. 233) I was much astonished at some of the assertions made by Dr. Crozier in SCIENCE for December 29, 1922. I can not hope to add to the admirable lucidity of Dr. Fisher's comment, but it does seem desirable to add special protest against Dr. Crozier's scornful dismissal of the idea of a "program" of oceanic investigation.

I have recently read Raphael Pumpelly's "Reminiscences" and I am now reading Jordan's "The Days of a Man." From these and other sources I get the overwhelming impression that when great problems of science have been successfully attacked by these men and their fellows there was in mind a definite program (or plan) of operations. As I understand it, the failure of the brilliant Rafinesque was primarily due to lack of plan.

The general difficulties of oceanic investigation seem to me to be somewhat similar to *those of astronomical investigation*. I can not imagine any one seriously suggesting that the Harvard, or the Yerkes, or the Lick, or the Mount Wilson Observatory should work without a program. Furthermore, what less than a program of some sort could justify the installation of a "stationary staff," or, indeed, make it possible to intelligently select such a staff?

Those of us who work day by day and year after year in the La Jolla laboratory are frequently and vividly impressed by the constant intercrossing of lines of influence between our respective fields and between indefinite numbers of minor points in each field. A major stimulus to continued investigation is the hope that we shall some time get enough accurate information to enable us to trace many of these lines of influence through the intricate web. This hope would be denied to us if we ignored the idea of a general program for all of our oceanic research.

Indeed, I know of nothing more satisfying to the scientific staff of the Scripps Institution than the fact that a program of some sort has been followed from the beginning and that a *permanent* program now seems to be definitely recognizable. All along one of the most prominent elements in our program has been the study of natural (in nature) activities of marine organisms as distinguished from (or at least compared with) circumscribed activities of such organisms in laboratories. Several years ago both Michael and Esterly showed through a series of statistical examinations of the marine population that laboratory deductions are not safe guides to interpretation of the intricacies of life in nature. McEwen's work in hydrography has even more strikingly shown the inadequacy of laboratory deductions. The success of all such studies has been largely due to following a program of operation.

Recently, Dr. O. T. Wilson, of the University of Cincinnati, arrived here with the statement that he was not committed to any special study and that he would like to do something to fit in with our work. As a result he is making some studies of floral successions on various kinds of surfaces in shallow waters with excellent results and with pleasure surely not to be surpassed by ignoring a general idea of plan in oceanic work.

W. E. ALLEN

SCRIPPS INSTITUTION,
LA JOLLA, CALIFORNIA

DEFINITIONS IN TEXT-BOOKS OF PHYSICS

I WISH to enter a protest, through your columns, against the continued use of two common expressions in text-books of physics, both of them true if properly interpreted, each of them capable of various interpretations and therefore inexact, unscientific and pedagogically wrong.

Year after year students tell us on the authority of text-books that "efficiency equals output over input," and year after year some of those students apply the idea to forces and confuse efficiency with mechanical advantage. "Output/input" is a form which lends itself to use in concise summaries of chapters on mechanics, but it is a stumbling-block in the path of just those careless or undiscriminating students who will most readily grasp that form of words in lieu of an idea. Such an expression as "output/input" means nothing in itself, because it might refer to anything, whether work, force, mass, volume or time; it means nothing unless it is defined, and if you must define it, why not use the definition directly? To be sure, it affords joy for a moment to the heart of a certain type of student, who, after struggling through a discussion of work as applied to machines till his brain is surrounded by a semi-luminous fog, turns over a page and suddenly sees a magic formula which he follows as a bright and shining light, a will-o'-the-wisp which lures him on to worse confusion than before.

The other practice to which I object is that of putting Newton's third law of motion into the form "Action = Reaction." What does it mean standing by itself on the page of an elementary text-book? It might refer to force, or to work, or to momentum, or even to that "action" whose leastness troubles the students of more advanced texts. Even the authors of the first book in which I ever saw a clear exposition of the third law of motion took pains to place before their own clear statement of the law the statement that Newton had put it in the form "Action is equal to reaction." Apparently even they, eminent physicists and understanding teachers as they are, felt obliged to pour out a libation to the shades of the original translators of Newton in the traditional way. My own experience in trying to teach with that book as a text has been that invariably some of the men who stood in greatest need of the clear statement were sure to learn the shorter and catchier statement which meant nothing to them. In some books the old form is the only formal statement of the law given, and, in spite of good illustrative explanations when they are given, it serves fairly effectually to prevent an understanding of the law as distinguished from an ability to parrot off a formula.

I am aware of the usefulness of very concise or semi-algebraic forms for gathering up and emphasizing the important points in a chapter, but there is also a grave danger of increasing the tendency of some students to fail to discriminate between a form of words as such and the real physical idea associated with it. This tendency is present even in the case of formulas and other very concise forms of statement which are perfectly accurate and definite, and is greatly aggravated in the presence of forms whose intended meaning does not necessarily follow from the words used. Two of the worst of the latter are those two which I have mentioned, and I should like to see them relegated by common consent to outer darkness, not afforded even the meager hospitality of a foot-note.

A. B. MESERVEY

DARTMOUTH COLLEGE

QUOTATIONS

MEDICAL RESEARCH

MEDICAL research is of so continuous a nature that attempts to review its progress at any given time are necessarily fraught with great difficulty. Observations and experiments which to-day assume large proportions may to-morrow seem relatively insignificant in the light of clearer understanding. On the other hand, labors which at this present hour appear to hold out but little promise of immediate utility may come to occupy a first place in the records of achievement. These facts should be borne in mind in considering the annual report of the Medical Research Council, a summary of which appears in another column. The number of investigators initiated or assisted by the council during the past year is so great as to be almost bewildering. These investigations, too, cover a field within the limits of which are included many other sciences distinct from medicine, yet, as is now known, ancillary to it. If certain observations appear to stand out from the others, and in consequence attract a larger share of attention, this fact must not be allowed to discount the possibility that the more obscure may yet prove to be the more important work. That proviso having been made, it may be acknowledged that the researches of the past year have been fruitful. New light has been obtained on some of the more recondite processes of nutrition. The importance of sunlight in the early years of life has found substantial and striking confirmation in the study of rickets carried on at the Kinderklinik in Vienna by workers from the Lister Institute and the Medical Research Council. Further, the discovery made at Toronto of a method of obtaining the anti-diabetic substance "insulin" seems likely to effect great changes in the treatment of this disease. That discovery belongs in no sense to the Medical Research Council, which merely recounts its history and pays tribute to its value. Nor, as our correspondent shows, have other scientific bodies been idle during the period under review. The papers submitted last night to the Royal Society of Tropical Medicine and Hygiene on the treatment of African sleeping sickness, if they do not profess finality, at least advance this difficult problem a stage farther towards solution. The German drug known as "Bayer 205," which was introduced to professional attention some short time ago, has afforded in the hands of British tropical disease investigators a large measure of success. Its failures are not less interesting or instructive; nor is the parallel between it and the preparation of arsenic, elaborated at the Rockefeller Institute and recently subjected to trial in Africa, without its significance. These observations, like the observations made at home and in temperate areas of the empire, have abiding value, whether or not the conclusions based on them remain valid. For they represent conscientious and disinterested work undertaken with no other idea than the advancement of knowledge. This quality of disinterestedness is the noblest possession of science. So long as it is maintained unsullied the faith which millions to-day repose in the exercise of human reason as the cure of human ills will not fail of justification.—*The London Times*.

SPECIAL ARTICLES

THE MINIMUM CONCENTRATION OF LUCIFERIN TO GIVE A VISIBLE LUMINESCENCE

LUCIFERIN is the substance of luminous animals which produces light when oxidized. An enzyme, luciferase, likewise found in luminous animals, must be present with luciferin for light production. In 1916[1] I calculated that one part of luciferin from an ostracod crustacean, *Cypridina*, in 1,700,000,000 parts of sea water, when mixed with luciferase, gave a light visible to the unaided eye. This figure is so much smaller than the concentration of substances detectible by ordinary chemical reactions, which at most run into the millions, that I have repeated these experiments, only to find that my preceding estimate may be bettered. The light from weaker solutions of luciferin than 1:1,700,000,000 can be seen.

In this work an important source of error has appeared which must be carefully guarded against and to which I call special attention below. The exact procedure of determining the minimum concentration is as follows: 0.0954 grams of dried *Cypridinae* are weighed out, ground in a mortar, dissolved in boiling[2] sea water and quickly diluted to 954cc cold sea water.[3] When filtered this forms the stock solution which contains one part dry *Cypridina* in 10,000 parts sea water. One part stock solution to 99 parts sea water gives solution A, that is, 1:1,000,000 solution, and one part of solution A to 99 parts sea water gives solution B, that is, 1:100,000,000 solution. If A is mixed with an equal volume of luciferase solution,[4] quite a bright light results. If B is mixed with an equal volume of luciferase solution,[4] a faint light results. B/2 gives a very faint light and B/4 gives a light so faint that the fully dark adapted eye can hardly detect it. Some sets of observations were made by myself and some by Mr. K. P. Stevens. We remained in a dark room for at least three quarters of an hour in order to increase the sensitivity of our eyes. In mixing the solutions, 5 c.c. of luciferase was poured into 5 c.c. luciferin in a test tube, 18 mm. in diameter. If we assume that B/2 is the solution giving light just detectable with the eye, note that its concentration is halved on mixing with an equal volume of luciferase, so that we can without doubt see the light from a B/4 or a 1:400,000,000 solution of the substances in dry *Cypridina*.

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[1] *Amer. Jour. Physiol.*, XLII, 335, 1917.

[2] Boiling destroys the luciferase, but not the luciferin.

The remainder of the calculation depends on the per cent. of luciferin in dry *Cypridina*. It must surely be less than 10 per cent. and, judging by the size of the luminous gland, greater than one per cent. We can, therefore, safely say that one part of pure luciferin in between 4 and 40 billion parts of sea water gives, upon oxidation, light visible to the unaided eye.

A similar experiment with luciferase shows that one part of pure luciferase in between 800 million and 8 billion parts of sea water will oxidize a stock luciferin solution with visible luminescence.

In the above work new glassware that had never been used for luciferin, or in fact for any other purpose, was employed. This is necessary as can be seen from the following experiment. A 100 c.c. graduate cylinder which had held the stock solution of luciferin (1 part dry *Cypridina* to 10,000 sea water) was washed in fifteen changes of hot water (not too hot for the hands). The graduate cylinder was then filled with sea water which stood in the cylinder for two minutes and was then tested with luciferase. A very faint light appeared. After standing five minutes the light from the sea water in the cylinder mixed with luciferase was brighter and after standing ten minutes quite a fair light was produced. Sea water which had not stood in this graduate cylinder gave no light with luciferase.

Evidently luciferin adsorbed on the walls of the cylinder is slowly liberated into the sea water. It is not removed by mere washing in fifteen changes of hot tap water. If I had used this particular graduate, supposedly clean, to hold any of my dilute solutions of luciferin it is obvious that serious error would have appeared in determining the minimum concentration of luciferin for luminescence.

Adsorption is no new phenomenon. We allow for it in dealing with the large surface areas of powders but generally overlook it on the surface of measuring vessels. However, adsorption is not to be neglected in an experiment dealing with parts per billion. The adsorbed body is especially likely to come off if the vessel is used with another solvent. Dye on the surface of glass that will not come off on washing in water may be removed by washing in alcohol or in slightly alkaline or slightly acid water.

I would suggest that the extraordinarily small concentration of Botulinus toxin necessary to kill mice (3×10^{-18} c.c. regularly and 3×10^{-21} c.c. sometimes) as reported by Bronfenbrenner and Schlesinger[5] may possibly be explained by "seepage" of adsorbed toxin from vessel walls in some such way as I have just indicated. One can not be more specific in pointing out any error in this work as the method of dilution of the crude toxin is not described in detail. A concentration of 10^{-21} c.c., however, requires careful scrutiny.

It is interesting to compare the minimum concentration for luciferin luminescence with the concentration of colored solutions at which the color is just perceptible. Mr. Stevens has made some determinations with dyes, such as methylene blue, acid fuchsine, gentian violet, methylene green, etc., in 18 mm. test tubes observed in the daylight from the side, and finds the limit of color visibility in the ten millions, one thousand times above the limit for luciferin luminescence. There is one exception, which concerns not transmitted light, but fluorescence. A faint greenish fluorescence of fluoresceine is clearly visible in the light from a powerful carbon arc focussed in the solution, with one part of the dye in 10 billion parts of ordinary distilled water. Such water is not by any means optically empty and light scattering from dust particles interferes with the observation of fluorescence. Spring[6] has reported that with optically empty water, the fluorescence from 10^{-15} grams per c.c. of fluoresceine can be detected in the beam of an arc lamp.

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[3] Rapidity in making dilution is essential to reduce spontaneous oxidation of luciferin to a minimum.

[4] 0.1 gram dry *Cypridina* to 100 c.c. cold sea water allowed to stand until luminescence ceases and filtered.

[5] *Jour. Am. Med. Assoc.*, 78, 1519, 1922; SCIENCE, LVI, 280, 1922; cf. Stehle, SCIENCE, LVI, 143, 1922.

Thus, luminescences from very small quantities of matter can be detected. We have an extreme case in the flash of light from impact of a single charged helium atom on fluorescent zinc sulphide. Biological reactions can not approach this in sensitivity, but I believe the value for *Cypridina* luciferin mentioned above sets a new record for chemiluminescence.

E. NEWTON HARVEY

PRINCETON UNIVERSITY,
MARCH 31, 1923

X-RAYS AND THE SEX CHROMOSOMES

IN two previous issues of this journal[1] the writer has reported what appeared to be the production of non-disjunction of the sex chromosomes of Drosophila by X-rays. When primary non-disjunction is found, as happens rarely, in ordinary cultures the two kinds of exceptional offspring do not occur in equal numbers. The exceptional sons which arise from the fermentation of eggs containing no X-chromosome by sperm containing an X-chromosome are considerably more numerous than the exceptional daughters which arise from the fertilization of eggs containing two X-chromosomes. Since the effect of X-rays is to increase proportionately the numbers of exceptional sons and daughters, the increased number of exceptional daughters obtained as a result of X-raying their mothers is considerably less than the increased number of exceptional sons. Up to the time of publication of the notes to which reference is made above, the data obtained showed clearly that X-rays caused an increased production of exceptional sons and probably also of exceptional daughters. Since that time the technique[2] has been improved and a large number of experiments have been performed. The data now accumulated make it reasonably certain that X-rays not only cause non-disjunction but that the exceptional daughters of X-rayed mothers are in most cases fertile and themselves produce exceptional offspring. Reference will here be confined to the third and fourth series of experiments which were performed with the improved technique. The results of the third series were stated at the Boston meeting of the American Association. The fourth series of experiments have only recently been completed.

The improvements in technique involved, among other things, using for the X-rayed mothers virgin heterozygous flies resulting from crossing white-eyed long-winged females with eosin-eyed, miniature-winged males. This made it possible to test for the presence of exceptional females among the flies to be X-rayed. After X-raying, the females were mated to wild-type males. The use for X-raying of females heterozygous for characters located in the sex chromosomes made it possible to follow individually by the characters of the offspring the sex chromosomes which had been submitted to X-rays. In the third series of experiments 76 females were X-rayed and 79 females were kept as controls. In each experiment the X-rayed and control females were sisters. The X-rayed mothers produced a total of 1557 regular sons, 42 exceptional sons, 1771 regular daughters and 8 exceptional daughters. Seven out of eight exceptional daughters were fertile and produced further exceptions. The control mothers, sisters of above, produced a total of 7,531 regular sons, 5 exceptional sons, 7,711 regular daughters and one exceptional daughter. The probability that the difference between the offspring produced by the X-rayed and control mothers was due to chance can best be calculated by a formula of K. Pearson[3] for the probable error of a difference, for reference to which the writer is indebted to Professor Pearl. Calculation shows that in the case of the exceptional daughters the difference between the number produced by the X-rayed mothers (8) and that which might be expected from the behavior of the control (mean = .46023) is 13.10 times the probable error of the difference, (.50751). The same quantity for the sons is 49.81 times the probable error of the difference. These numbers make it practically certain that the difference is not due to chance. Every cause for the difference except X-rays seems to have been eliminated from the experiments—the control and X-rayed females were sisters emerging at approximately the same time, were kept at the same temperature, etc.

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[6] Acad. Roy. de Belg. *Bull.* Class. sc., 1905, p. 201-211.

[1] "On the elimination of the X-chromosome from the egg of Drosophila melanogaster by X-rays," SCIENCE, Vol. LIV, pages 277-279, September 23, 1921; "The production of non-disjunction by X-rays," SCIENCE, Vol. LV, pages 295-297.

[2] The technique of these experiments is described in detail in a paper submitted to the editors of the *Journal für Experimental Zoology.*

In the fourth series of experiments all the mothers, both those which were X-rayed and those in the controls, were the daughters of one white-eyed female by two eosin-eyed, miniature-winged males. The 26 X-rayed females produced a total of 1,934 regular sons, 42 exceptional sons, 2,173 regular daughters and 8 exceptional daughters. Seven of the eight exceptional daughters were fertile and produced exceptional offspring. The 19 control females produced a total of 5,109 regular sons, three exceptional sons, 4,985 regular daughters and one exceptional daughter. The difference between the number of exceptional daughters produced by the X-rayed females and those produced by the control females is 9.425 times the probable error of the difference. The same quantity for the exceptional sons is 41.00 times the probable error of the difference. The fourth series of experiments therefore confirms the findings of the third series. The results of the two series of experiments may be added together. In this case we find that the difference between the number of exceptional daughters (16) produced by the X-rayed females and the expected mean (.9354) is 20.17 times the probable error of the difference.

The exceptional daughters of the X-rayed females were of two kinds. Four of those in the third series were homozygous for both of the sex linked characters and were therefore formed by equational non-disjunction. Three of those in the third series and seven of those in the fourth series were heterozygous and therefore formed by reductional non-disjunction. Two of the exceptional daughters not included in the above two kinds were homozygous for one sex linked character and heterozygous for the other. Their constitution and the explanation of their occurrence will be discussed at a future date. It is clear from the results of the experiments described that X-rays may cause non-disjunction during either the first or the second of the maturation divisions and that the exceptional condition of the females produced by it, consisting in the possession of two X chromosomes and one Y chromosome, is transmitted to a proportion of their offspring. There is therefore in this effect of X-rays on the germ cells a very clear case of an external agent which modifies the mechanism of inheritance in such a way that a permanent effect is produced on the germ cells.

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OKLAHOMA ACADEMY OF SCIENCE

THE eleventh annual meeting of the Oklahoma Academy of Science was held in Oklahoma City on February 9, and at the University of Oklahoma, Norman, on February 10. The following papers were read:

Responses of bruchus to modified environments: J. K. BREITENBECHER.

The Isleta Indians: ALBERT B. REAGAN.

Some birds of the Oklahoma Panhandle: R. C. TATE.

Additional evidence on the possibility of the redemption of the great plains from its semi-arid condition: J. B. THOBURN.

The possible contribution of the motion picture in the effective teaching of history: J. W. SHEPHERD.

Present-day objectives in physics: HOMER L. DODGE.

Present-day objectives in zoology: A. RICHARDS.

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[3] On the influence of past experience on future expectation, *Phil. Mag.*, Sixth Series, Vol. XIII, page 365.

Observations on the removal of the semi-circular canals from baby chicks: L. B. Nice and C. L. Furrow.

Buried mountain ranges in Oklahoma: Charles N. Gould.

Sources and uses of direct current in high school laboratories: B. C. Brouse.

An interesting problem in bird study: R. O. Whitenton.

Nesting records for 1920 to 1922 at Norman, Oklahoma: Margaret M. Nice.

The identification and ecology of an epiphytic fern included in the Oklahoma cryptogamic flora: M. M. Wickham.

Unilateral inheritance in bruchus: J. K. Breitenbecher.

The acceleration of fission rate in paramœcium: Dixie Young.

Concentric corpuscles of the palatine tonsils: J. M. Thuringer.

A note on the migration of miriapoda: J. M. Thuringer.

The parasites of dogs and cats in Oklahoma: John E. Guberlet.

Observations on the egg laying of the cow pea weevil: Alfred Brauer. Introduced by J. K. Breitenbecher.

The skeletal development of a 23-year old elephant compared with that of man: Ed. Crabb.

The fall grasses of Cleveland County: C. W. Prier.

Notes on the effect of urea on the diffusibility of $MgSo_4$*:* Alma J. Neill.

Notes on biological survey: C. W. Shannon.

A new geologic map of the Arbuckle Mountains of Oklahoma: C. E. Decker.

A study of some conglomerates near the eastern limits of the redbeds of Oklahoma: F. O. Evans.

Some phases of the Permian between the Arbuckle and Wichita Mountains, Oklahoma: E. R. Brockway.

Phosphate rock in Oklahoma: A. C. Shead.

Chemical composition of Oklahoma sand barite rosettes: A. C. Shead.

The Osburn fault of northern Idaho: J. B. Umpleby.

An analysis of drillite and its bearing on the possible formation of igneous rocks from preexisting sedimentaries: A. C. Shead.

Chemical composition of the Black Mesa: A. C. Shead.

Building materials of Oklahoma: M. C. Oakes.

An interpretation of certain peculiarities of the Canadian river basin of western Oklahoma: C. F. Bollinger.

Evidence of Permo-Pennsylvanian glaciation in the Wichita Mountains: S. Weidman.

Outline of the structural geology of the Ouachita Mountains of Oklahoma: C. W. Honess.

Notes on the paleontology of the Comanchean of Love County, Oklahoma: F. M. Bullard.

Summarized data on the structural history of Oklahoma: Bess U. Mills.

Some observations on the South Canadian River near Norman: O. F. Evans.

An example of an Indian picture writing in the Wichita Mountains: S. Weidman.

Present status of science work in Oklahoma: C. W. Shannon.

Distribution of taxes in Oklahoma: F. F. Blachly.

The simple rigidity of a drawn tungsten wire at incandescent temperature: William Schriever.

The cause of the optimum angle in a receiving conical horn: Victor A. Hoersch.

An electrometer for measuring the radioactivity of gases from oil and gas wells: Forrest K. Harris.

A boy's vocabulary at eighteen months: George F. Miller, Margaret D. Miller and Margaret M. Nice.

An experiment in automatic spelling: Herbert Patterson.

The magnetism of the map: Sophie Altshiller Court.

Some problems in vocabulary testing: George F. Miller.

A comparison of the sizes of the vocabularies of fifty children of the same age: Miriam Oatman-Blachly.

A special feature of the program at the annual dinner, held on February 10, was the centennial celebration of the birth of Louis Pasteur and Gregor Mendel. The following program was presented:

Pasteur's contributions to chemistry: C. L. Nickolls.

Pasteur's contributions to bacteriology and pathology: Gayfree Ellison.

Louis Pasteur—the man: L. B. Nice.

Gregor Mendel: A. Richards.

The following officers were elected for the ensuing year:

President, S. Weidman, Norman, Oklahoma; *first vice-president,* John E. Guberlet, Stillwater, Oklahoma; *second vice-president,* Frank G. Brooks, Oklahoma City, Oklahoma; *secretary,* L. B. Nice, Norman, Oklahoma; *treasurer,* J. K. Breitenbecher, Norman, Oklahoma; *curator,* Fred Bullard, Norman, Oklahoma.

L. B. Nice,
Secretary

Norman, Oklahoma

THE NEW HAVEN MEETING OF THE AMERICAN CHEMICAL SOCIETY

The sixty-fifth general meeting of the American Chemical Society was held at New Haven, Connecticut, Monday, April 2, to Saturday, April 7, 1923, inclusive. The council meeting was held on the second, the general meeting on the morning and afternoon of the third, and divisional meetings all day Thursday and Friday. Excursions took up the whole of Saturday. These excursions covered numerous manufacturing plants, not only in New Haven, but in the surrounding cities and towns. A feature of the meeting was the dedication of the Sterling Chemistry Laboratory, which was under the auspices of Yale University and to which all day Wednesday was given. A second council meeting was held on Wednesday afternoon, with the approval of the authorities at Yale. Full details of the meeting will be found in the May, 1923, issue of *Industrial and Engineering Chemistry*. The registration was slightly over 1,200, with approximately 100 ladies attending the meeting. A considerable number of members, estimated at 200, attended the meeting, who, coming in the last two days, did not register for the main part and did not realize the necessity of registering and paying the registration fee to help carry the expense of the meeting, as voted by the council.

A general public address was given by Francis P. Garvan on Tuesday morning entitled "Chemistry and the public." Sir J. J. Thomson addressed the society on Wednesday evening on "The unity of physics and chemistry."

At the general business meeting held Tuesday morning resolutions and tribute were presented to our late honorary member, Edward W. Morley. These resolutions will be found printed in the council minutes.

At the general meeting on Tuesday afternoon the following general papers were presented:

Chemistry and our food resources: Carl L. Alsberg.

The history and status of chemistry petroleum research: C. O. Johns.

The baker turns to the chemist: H. E. Barnard.

The influence of light on inorganic material and life processes: Oskar Baudisch.

Cellulose silk: W. O. Mitscherling.

The influence of modern chemistry on pharmacology: Arthur Hirschfelder.

The following divisions and sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Cellulose Chemistry, Dye Chemistry, Industrial and Engineering Chemistry, Chemistry of Medicinal Products, Organic Chemistry, Petroleum Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry, Water, Sewage and Sanitation; Sections of Chemical Education, Gas and Fuel Chemistry and History of Chemistry. Further details of their meetings will be found in the May issue of *Industrial and Engineering Chemistry.*

On Monday evening a complimentary banquet to the council, attended also by many members of the society and a large number of the members of the New Haven Chamber of Commerce, was given by the New Haven Chamber of Commerce to the council at the Taft Hotel. Many speakers of prominence were listened to and the banquet was an occasion long to be remembered by those who were fortunate enough to attend.

On Tuesday evening a very enjoyable smoker was tendered by the New Haven and Connecticut Valley Sections in the dining hall of Yale University. The special feature was a dramatical allegory entitled "Iono and Faradette, a chemical ballet" written by Daniel Caldwell Long and John Arrend Timm. The play was beautifully staged, was extremely interesting and was thoroughly appreciated by all present.

At the dedication exercises at Sterling Chemistry Laboratory the gathering was addressed by Past President Edgar F. Smith on "The history of chemistry in America with special reference to Yale." The building was presented to the university by the Sterling trustees and accepted by President Angell with proper reply. President Franklin replied also for the society when it was presented to the society for its use during the meeting. The university tendered a complimentary luncheon to all members and guests the same day at one o'clock in the university dining hall.

On the evening of the fifth an indoor polo game was staged for the members in the Yale Armory. On the sixth a reception and dinner was given to the members and guests in Woolsey Hall and was accompanied by dancing, many ladies being present. The scientific program was extensive, 375 papers being presented.

Charles L. Parsons,
Secretary

SCIENCE

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RESEARCH IN SOME ASPECTS OF DISEASE ASSOCIATED WITH THE FIELDS OF ZOOLOGY, ENTOMOLOGY AND PARASITOLOGY[1]

IN no other domain of medical science has such progress been accomplished within the past two decades as in that of medical zoology, entomology and parasitology, and it is significant that the great majority of the discoveries upon which this progress is based have been made in connection with the elucidation of the etiology and methods of transmission of the tropical infectious diseases. For, the abolition and prevention of a number of these diseases, obviously based upon such discoveries, has constituted one of the great triumphs of the science of medicine. Discoveries of the relation of insects to disease have in some instances revolutionized our attempts to prevent and control some of the most devastating infections. In fact, it is very largely through the discoveries of the cause and methods of spread of the serious epidemic diseases that preventive medicine has progressed from a blundering art of forty years ago to its present important position among the medical sciences.

However, while very great progress of this nature had been made in earlier years by the recognition of the value of vaccination against smallpox by Jenner in 1796, and of the discovery of the causative organisms of tuberculosis, typhoid fever and Asiatic cholera from 1880-1883, scientific advances of an entomological nature in connection with disease materialized only later and did not begin to be made for nearly another decade. Thus, although man in his conquest and discovery of new territory made through various explorations both by sea and land during the fourteenth to the nineteenth centuries gradually acquired through his conflict with devastating disease considerable epidemiological evidence, and became familiar with certain popular beliefs and even sage suggestions intimating that several infectious diseases might be spread through the agency of insects, it was not until 1879 that Manson demonstrated that the mosquito *(Culex fatigans)* served as a host for the parasite *Filaria bancrofti*, and that this parasite underwent at least a portion of its life-cycle therein. In the following year Laveran discovered the parasite of malaria, and in 1893 Theobald Smith demonstrated that the disease Texas fever was transmitted by the cattle tick *(Boophilus bovis)*. Following these discoveries there came a series of brilliant investigations which have led to much of the remarkable progress recently made in preventive medicine. In spite of the great importance and far-reaching application of many of these discoveries which have related to practically all of the important and widely prevalent tropical infections, lack of time will permit only a very brief reference to some of those which are of greater significance to-day.

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[1] Read at the annual meeting of the American Association for the Advancement of Science, December, 1922.

Obviously, there are many interesting problems relating to even those fields of medical zoology and entomology already well trodden that still await solution. Considering for a moment the aspect of diseases caused by protozoa, it is of interest to recall that while the parasite causing visceral leishmaniasis or kala azar was discovered in 1903, and there has been published since that time much experimental evidence in favor of the transmission of the disease in India by *Cimex rotundatus*, and on the shores of the Mediterranean by *Pulex cerraticeps*, the most recent work has thrown considerable doubt upon the transmission of leishmaniasis by either of these insects. Particularly from the investigations of Patton we know that the parasites ingested from the peripheral blood of cases of kala azar develop into a flagellate in the stomach of *Cimex rotundatus*, and may persist for as long as forty-one days, very much as Rogers has shown that they may in the blood agar culture tube. Patton suggests that by the crushing of the infected bedbug upon the skin human infection occurs. However, it would appear that we are to-day no nearer the final solution of the problem of the transmission of visceral leishmaniasis than we were ten years ago. Also, the relationship between the human disease and the similar associated canine leishmaniasis which occurs particularly in the Mediterranean and Caspian Sea regions still requires an explanation in view of the absence of the latter from other important endemic centers such, for example, as India. A serum test for the diagnosis of kala azar, known as the "formol gel" test has recently been described. The test is performed by the addition of several drops of commercial formalin to about 1 c.c. of clear serum. In a case of kala azar the mixture becomes viscid immediately and within a few minutes jellied and opaque like the white of a boiled egg, while with other diseases, such as malaria and syphilis, the reaction is delayed for a considerably longer period, up to twenty-four hours. A wider application of the test and of its significance is, however, desirable.

Recent experiments have demonstrated that *Phlebotomus paptasii* can harbor for at least three days the virus of Oriental sore, and that such flies when crushed and rubbed into a scarified area of the skin will after a proper incubation period produce a lesion in which leishmania are demonstrable. However, it is only by further investigations that the origin of the virus in this fly, and whether it is derived from a reservoir or is a natural flagellate infection of the fly, as well as the exact mechanism of infection in nature, can be determined. There is little definite evidence that the gecko, *Tarentola mauritanica*, may act as the reservoir for the virus of Oriental sore, although this has been suggested on the ground that this lizard is ravenously fed upon by sand flies, and that in certain regions fifteen per cent. of the geckos contain a flagellate of the leptomonas type.

Very interesting are the observations which have recently been made regarding the occurrence of flagellates of plants, chiefly euphorbias, and the suggestions that they may be a natural source of insect infection. Laveran and Franchini have reported the successful inoculation of healthy euphorbias of two species with pure cultures of *Herpotomas stenocephali* var. *Chattoni*, and have also infected white mice with latex of *Euphorbia nereifolia* naturally infected with leptomonas, subsequently finding leishmaniform parasites in the blood of the mice that survived the experiment. Franca previously had failed to infect animals with *Leptomonas davidi* from latex of euphorbias, but he did not experiment with the insect-borne strain of the parasite.

A very great advance has been made in the discovery of the value of tartar emetic in the treatment of leishmaniasis. Formerly the death rate from kala azar in India in untreated cases varied from seventy to ninety-eight per cent., while through the use of repeated intravenous injections of from two to ten c.c. of a sterile one per cent. solution of tartar emetic the mortality has been very greatly reduced. Thus Dodds-Price has reported during the past year a series of over two thousand injections of tartar emetic in the treatment of cases of kala azar with sixty-seven per cent. rate of recoveries. However, this drug is very toxic, and its use in human beings is attended with some danger. A number of reliable investigators have reported deaths due to poisoning in the doses recommended. In some of the fatal cases fatty degeneration of the heart, liver and kidneys was noted. Much that we should know in regard to tartar emetic is still undetermined. The formula of it is even not certainly known. No satisfactory method of preparing a suitable stable solution for injection has been discovered, and it is not known exactly what chemical change occurs when the drug is submitted to sterilization in the autoclave. It is so irritating locally that it can not be used advantageously except by intravenous injection. Its method of excretion from the body is also not certainly known, and whether it remains as antimony potassium tartrate in the circulating blood, or whether it combines with a constituent in the body of the patient before destroying the parasite, has also not been ascertained. Since tartar emetic has proved to be not only of so great value in this disease but also in the treatment of bilharziasis, trypanosomiasis and granuloma inguinale, it is highly important that we should have more accurate pharmacological knowledge regarding it. Weiss and Hatcher have recently shown that tartar emetic (antimony and potassium tartrate) induces vomiting reflexly through local irritation after its introduction into the stomach or duodenum, and that it does not cause emesis in the cat or dog when it is applied directly to the vomiting center described by Thumas and which lies in the floor of the fourth ventricle. It is particularly on account of the powerful destructive and irritant action upon the gastro-intestinal tract that the drug can not be satisfactorily given by the mouth in the treatment of infectious processes. Intravenous injections of tartar emetic induce vomiting after varying intervals of time largely dependent on the size of the dose. This emesis is not prevented by the removal of the gastro-intestinal tract, or by the removal of the celiac plexus and simultaneous cutting of the vagi below the diaphragm, but it is profoundly influenced by cutting these nerves in the neck or by paralyzing the vagus endings with atropin. It is also apparently abolished by severing all nervous connection between the heart and centers, by removal of the stellate ganglia and cutting the vagi in the neck in the cat.

Of the recent compounds of antimony, p-acetyl-amino-phenyl-stibinate (stibacetin) appears in some ways to be the most favorable for use, and Brahmachari has found that urea stibamine is a much safer antimonid for use in the treatment of kala azar than tartar emetic or other antimonyl tartrates. There are many difficulties in employing aromatic compounds of antimony which are with a few exceptions non-crystallin and the construction of an efficient less toxic and stable preparation of antimony still remains one of the most urgent problems of tropical medicine. Further work upon this subject is being pursued in my department at the Harvard Medical School.

With reference to malaria, while approximately forty years have passed since the species of plasmodia infecting man were described, there is still no complete agreement as to whether there are really three or only one polymorphic human species. Both Grassi and Plehn believe and support the idea that there is but one parasitic species, the form of which changes with the season. While the existence of double or even in some instances of triple infections with the three species might explain many of the apparent transitions in form from one to another, there is still considerable difference of opinion on the subject. It is generally admitted from the classical experiments of Grassi, Bignami and Bastianelli performed in 1898 that only certain species of anophelinæ may transmit human malaria, and also that *culex* and *stegomyia* are not carriers of malaria, but there has been no satisfactory scientific explanation of why this is so. These facts can not be explained upon the ground of geographical distribution, numerical prevalence, zone of flight, length of life, food supply or other different habits of these mosquitoes. In this connection it is interesting to note that the different species of anopheles capable of carrying malaria and playing a large rôle in nature in this respect come from the most divergent groups of the sub-family. In Europe and northern America, according to the classification of James, the relatively primitive protoanophelines are the active agents. In the new world an offshoot of this the true cellia group are the carriers. In the old world the totally distinct deutero-anophelines furnish practically all the carriers, while in Australia and New Guinea the neo-anophelines, an offshoot of the same stock, come into prominence. Many species of *anopheles*, *culex* and of *stegomyia* will transmit *Filaria bancrofti*, and Ross and others have demonstrated the full development of *Proteosoma precox* in species of *culex*, particularly *fatigans*.

To-day we know that *Hæmoproteus noctuæ* (Celli and San Felice) and *H. Syrnii* (Mauer), parasites of avian anemia, are also transmitted by *Culex pipiens* (Linnæus) and *Culisetta annulata Schrank* (Theoboldi). However, no one has demonstrated the entire development of the human malarial parasite in *culex* and it is generally believed that there is no evidence of the existence of malaria without some of the anophelinæ. Daniels is inclined to suspect that the ædinæ found in jungles may transmit malaria in such localities, but this has not yet been determined by experiment.

This contraction of malaria in uninhabited jungles has again raised the question of whether some other animal than man may not also act as an intermediate host for the human malarial parasite.

Donovan, having found *Plasmodium pithici* in the orangoutang and *Plasmodium kochi* in several species of monkeys, made the attempt to determine whether the infection in human beings in the jungle might not be attributable to infection from monkeys. He, however, found no human plasmodia in seventy-six *Macacus sinicus* or in ten *Presbytis priamus* from the forests near Madras, but he detected a parasite very like *Plasmodium vivax* in the Malabar squirrel, *Ratufa indica malabarica*. In this connection one may recall that all specific human parasites must have had an origin outside of the human species, and probably pursued their evolution independent of man. Nevertheless, if one finds a protozoan parasite in an animal even extremely similar to one affecting man, it would be precipitous to conclude that the two parasites are identical or had the same origin without the additional proof that the animal may be infected with the human species. Manson suggested that cave-dwelling bats may have been the original source of human malaria. However, attempts to infect flying foxes or fruit-eating bats of the species *Cynonycteris straminea* with *Plasmodium falciparum* and *P. malariæ*, both by specific inoculation and by exposing them to the bites of *anopheles*, have failed. A number of investigators have observed *plasmodia* in the higher apes, and Mesnil and Roubaut have succeeded in infecting chimpanzees with both benign and with malignant tertian malaria by direct inoculation, but not with bites of *Anopheles maculipennis*. Both infections died out shortly and naturally.

Reichenow believes that he has found in the gorilla and chimpanzee in West Africa all the forms of *plasmodia* which infest man, and he confidently asserts that the anthropoid apes are as sure a source of danger to Europeans living in those parts as are negroes. Still more recently Blackloch and Adler in a chimpanzee in West Africa have also found both small rings and crescents morphologically indistinguishable from *Plasmodium falciparum* and apparently identical with the parasite described by Reichenow. Further confirmation of this work is desirable.

Some work of considerable significance has recently been performed which may help to explain the condition known as dormant or latent malaria and its relation to relapse.

Grassi and Schaudinn attribute the origin of relapse to pathogenesis of macrogametes, and Ross to the persistence of a few schizonts. Whitmore in a study of bird malaria has shown that the blood of infected canaries remains infective by injection for at least twenty-nine months after parasites have ceased to be discoverable in the blood by a microscopic examination.

E. Sargent had also observed persistent infection after apparent disappearance (as determined by microscopical examination) of the parasite from the bird's blood, by demonstrating that its blood is still infective for *culex*.

Until very recently comparatively little was definitely known regarding the time that *anopheles* might remain infective after biting a malarial patient. A number of observers had claimed that *anopheles* generally lose their power of infection after hibernating, and that those which have hibernated during the winter are not able to produce infection in the spring unless they themselves become reinfected.

Wenyon, however, has recently shown that if infected *anopheles* were placed in an ice chest between 9° and 12° C., oocysts already formed became degenerated in every case. If, however, the temperature was only lowered to that of the laboratory, development of the oocysts could be temporarily arrested for as long a period as three weeks and then revived again when the mosquitoes were placed in the incubator.

Mayer infected *culex* with the *proteosoma* of birds and found five weeks later that not only the insects' salivary glands but also the muscles of the body and appendages of the palpi contained numerous sporozoites. Fifty-two days after the infective feed, isolated sporozoites could be detected in the muscles. This suggests that under certain conditions the sporozoites may persist for longer periods in these locations than in the salivary glands.

Finally, Mayne has shown that *plasmodia* of malaria were detected in the salivary glands of five specimens of *Anopheles punctipennis*, kept at a temperature of 44° to 78° F., from sixty-eight to ninety-two days after infection, and that *plasmodia* of malaria were proved to be viable by inoculation into a human host by the bite of a mosquito which had been infected fifty-five days previously. Thus under certain conditions the carriage of malaria through the winter by the mosquito would seem to be a possibility.

It is almost certain that hereditary infection of the mosquito does not occur. Schaudinn claimed to have observed sporozoites of the benign tertian parasite in the ovaries, but this observation has not been substantiated. Mayer and Muhlens both found sporozoites in the vicinity of the ovaries in infected *culex* and *anopheles*, but not within these organs.

Great confusion still exists in regard to the subject of immunity in malaria. Complete natural immunity for man depending on the presence in the blood of substances which prevent any development of the naturally inoculated virulent human malarial parasites in considerable number is doubtful, and the relationship of partial natural immunity to latent infection in which symptoms are long delayed beyond the usual incubation period of the disease has not been satisfactorily explained. On the other hand, partial immunity or tolerance of the infection without evident symptoms of disease is apparently generally acquired gradually by frequent infections and reinfections repeated continuously during a number of years. Such infections include the malarial carriers. Whether the acquired immunity ever becomes sufficient by the production of specific antibodies unaided by drugs to destroy all the parasites, and to sterilize the patient, is still questionable. The brothers Sergent, in studying the immunity of canaries to avian malaria, found that the normal immunity rate in 965 canaries was 0.72 per cent. By injecting blood taken from a canary during the incubation period after an experimental infection, the immunity rate in canaries could be raised to 21.3 per cent. in 61 canaries. Finally, by the injection of sporozoites kept in vitro for twelve to forty-eight hours, the immunity rate in 24 canaries could be raised to about 30 per cent. Further extension of these interesting experiments is also highly desirable. Cremonese believes with others that as mosquito infection with malaria is greatest in the autumn, consequently primary infection must in the main be then acquired. He further believes that the first evidence of symptoms of the malarial attack occurring in the spring is due to the effect of climate acting upon humoral antibodies, in cases of long latent malarial infection. Primary latency is held to be the rule in malaria and natural immunity to depend upon the parasites acting as antigen, but only as long as they are extracorpuscular. Once the parasite becomes intracorpuscular, complement is held to be powerless to unite with antibody. In connection with this subject the influence of sunlight in the spring as well as of ultraviolet rays upon the development of latent malarial infection and relapse has recently been emphasized by Whitmore.

With reference to quinin, still the most specific drug in the treatment of malaria, the brothers Sergent found in experiments in which *Plasmodium relictum* was injected into canaries, and daily injections of quinin given, in only one case was there evidence of the development of a strain resistant to quinin, this character being retained in full during its passage through two other canaries and in lessened degree through a third. It appeared in a canary kept quininized for nine months without symptoms, these, then, appearing in spite of the continuation of the quinin. From twelve experiments they conclude that to administer prophylactic quinin before there is risk of infection is useless. Macht has recently shown that the toxicity of quinin sulphate is much greater when injected into frogs if these animals are exposed to sunlight than it is when they are kept in the dark. Further experiments revealed that it was the light waves from the violet end of the spectrum that were the most effective in increasing the toxicity of quinin and quinidin. In other experiments the rays of an electric arc lamp were utilized instead of sunlight, and the same potentiation in toxicity was qualitatively noted. It would be of interest to ascertain whether this increased toxic action is associated with the property of fluorescence.

The relationship of the wild game to human sleeping sickness and the controversy as to whether human trypanosomiasis is communicated to man by *Glossina morsitans* that has been infected with trypanosomes from feeding on wild animals, is far from being settled. However, the recent experiments of Taute and Huber in which Taute inoculated himself and Huber and one hundred and twenty-nine natives with blood containing virulent *Trypanosoma brucei* from naturally infected animals without obtaining a single human infection go far indeed towards demonstrating that *Trypanosoma brucei* of Nagana and *Trypanosoma rhodesiense* of human trypanosomiasis are not identical.

A large amount of research has been recently performed regarding the chemotherapy of trypanosomiasis. Pearce has recently called attention to the good results obtained with tryparsamide and exceedingly favorable reports have been given of the efficacy of a new preparation known as "Bayer 205" in the treatment of trypanosomiasis both in man and animals. The preparation is stated to be much more efficient for this purpose than atoxyl and antimony, and much less toxic. However, it is not harmless for man since it has an effect upon the blood and the kidneys, in moderately large doses causing destruction of erythrocytes, anemia and albuminuria. Albuminuria has also been observed in man sometimes after quite small doses. It usually does not appear until some days after the injection of the drug. The substance circulates in the blood for weeks and even months, so repeated doses must have a cumulative effect. For man a ten per cent. solution has been recommended, 0.5 gram being given at the first dose, and, if this is well borne, twenty-four to forty-eight hours later one gram intravenously, up to three grams within a week. After this there should be at least a fourteen-day interval with a careful examination of the urine. Many of the cured animals remain immune against subsequent infection for weeks and months. Pfeiler has treated horses suffering with dourine with this preparation. Some of the animals have apparently been cured, but in other cases the treatment has failed. The serum of healthy rabbits previously injected with this drug is therapeutically active, and it is possible to cure rats and mice infected with *Trypanosoma brucei* with such rabbit serum removed up to fifty-one days after the injection of "Bayer 205." The drug perhaps combines with some element in the serum before directly killing the trypanosomes. If this is substantiated it would appear that "205" is a protoplasmic poison which acts in this connection in a somewhat similar manner to several other chemotherapeutic preparations recently investigated. Thus it has been suggested that an organic compound containing arsenic, as salvarsan for example, does not itself directly kill the spirochætes, but that the cells of the patient must in some way cooperate, perhaps by oxidizing this substance. A somewhat similar action has been suggested for emetin. Dale and Dobell found that when emetin is applied to fresh amœbæ taken from the dysenteric lesions, it has a surprisingly weak action on these organisms, and that they were still motile after contact for two hours in a one per cent. solution of emetin hydrochlorid. Dale then prepared certain derivatives of emetin and found that di-methoxy-emetin was ten times as poisonous for the amœbæ and not nearly as poisonous for the animals (cats) as emetin, but it had no therapeutic effect whatever. Hence, it was concluded that the curative action of these alkaloids was proportional not to their direct poisonous action on the amœbæ, but to their poisonous action on the patient, and it is suggested that the body of the patient must play an essential and perhaps a primary part in the killing of the parasite. However, the experimental difficulties in connection with the chemotherapeutic study of emetin in cats infected with amœbæ are considerable, and it is exceedingly desirable that the problem should be approached in other ways. The further study of the nature of the reaction between these chemotherapeutic agents and the cells of the patient and the final action upon the parasite is exceedingly important.

A vast amount of research has in recent years been carried on in relation to the spirochætal diseases and their methods of transmission. The exact systemic position of these microorganisms has been productive of considerable controversy since Schaudinn in 1905 discovered the species specific for syphilis and named it *Spirochæta pallida*. However, their zoological position has not yet been satisfactorily determined and there is still considerable dispute as to whether the spirochætæ should be classified with the protozoa or with the bacteria, or in an intermediate kingdom, the protista. Recent investigations show that they possess a firm but flexible periplast and multiply by both longitudinal and transverse division. By differential staining they may be seen to possess bars or rods which stain deeply and assume a chromatin tint, while some species show a non-undulatory membrane. According to Balfour, Leishman and others, a resting or resistant stage, the granular stage, constitutes an important phase in the life-cycle of the spirochætes, and is supposed sometimes to explain the infection of the offspring of the intermediate hosts, ticks or lice, and also the human relapses when the blood stream is flooded with parasites, developed apparently from the granules located in the internal organs. While the nature of the chromatinic granules produced by spirochætes has been much discussed, there is still not unanimity of opinion regarding them. Marchoux and Couvy, Wolbach and Betances consider the granules or coccoid bodies to be degeneration products. Leishman, Bosanquet and Fantham, however, do not coincide with this view. Leishman believes that he has seen young spirochætes apparently attached to a granule clump suggesting what might be interpreted as growth of a spirochæte from a granule.

Sergent and Foley have recently shown that monkeys can be infected with human blood containing no visible spirochætes, and they believe that the virus of recurrent fever may exist in the blood of man and also in the louse in a very minute form. The existence of this cycle or form, they declare, is an argument in favor of the relationship of the spirochætes of relapsing fever to the protozoa.

Todd believes that it is only by definitely seeing granules grow to comma forms, and commas to spirochætes, that the development of spirochætes from granules can be demonstrated. Balfour has more recently observed a development of some of the granules from the malpighian tubes in ticks into spirochætal-like forms, but he has been unable to trace a complete cycle of development in the tick. Possibly by the continuous observation of these organisms kept at favorable temperatures in a moist chamber, and examined by direct illumination and also with the darkfield, further information regarding this question may be obtained.

Since Schaudinn's discovery of *Spirochæta pallida*, five other important species of *spirochætæ* causing disease in man have been described: *S. pertenuis* by Castellani in 1905 as the cause of yaws, *S. bronchialis* by Castellani in 1907 as the cause of bronchial spirochætosis, *Leptospira icterohæmorrhagiæ* by Inado and Ido in 1914 as the cause of hemorrhagic jaundice, *Spirochæta morsus murium* in 1915 by Futaki as the cause of rat-bite fever, and *Leptospira icteroides* by Noguchi in 1919 as the cause of yellow fever. *Spirochæta schaudinni,* which has been described as the cause of ulcus tropicum, can hardly be differentiated morphologically from *Spirochæta refringens* discovered by Schaudinn and found by him in syphilitic lesions of the external genitalia and in open ulcers of the skin. While there are some suggestions in the literature indicating the pathogenicity of *Spirochæta eurygyrata* Werner in the intestine in man, the recent investigations would indicate that further studies on this subject are desirable. Hogue did not find the coccoid bodies described by Porter as a means of transmitting this organism, but she was able to cultivate this spirochæte in a medium consisting of 15 c.c. of 0.85 sodium chlorid solution and 0.3 c.c.. of sterile serum water, with a p_{H_7} reaction, the tubes being covered with paraffin oil.

There are a number of recent reports in the literature calling attention to the prevalence of the condition known as bronchial spirochætosis. *Spirochæta bronchialis* can hardly be distinguished structurally from *Spirochæta refringens.* There is considerable evidence which shows that the spirochætes in the sputum in this condition are really oral spirochætes which have found a suitable medium in the bronchi, particularly in tuberculosis and other pathological conditions of the lung, and there is not general agreement regarding the acceptance of bronchial spirochætosis as a distinct disease.

Vincent believes as do a number of others that the lung condition in spirochætal bronchitis is due to invasion of the bronchi by the same organisms which occur in Vincent's angina, and that *S. bronchialis* is identical with *S. vincenti.*

It is interesting to note that with reference to transmission only one species, *Leptospira icteroides,* has been demonstrated to be transmitted by insects, *Stegomyia calopus. Spirochæta bronchialis* is said to be transmitted from man to man by coccoid bodies or granules through droplet infection in coughing, the coccoid granules being more resistant to drying than the spirochætes. With reference to the different species of spirochætes which have been described for relapsing fever in different parts of the world, it seems very doubtful if these various forms really constitute distinct species, since the experimental methods employed for their differentiation and based upon immunity reactions are not entirely reliable for the separation of species of these spirochætes. Nevertheless, in the literature of the past year one finds two more species described as new and different from those hitherto described. Still more recently Blanchard and Lefrou have reported a spirochæte in the blood in blackwater fever, *Spirochæta bilio hemoglobinuriæ,* and Couvy has observed another species in the prefebrile period of dengue fever.

Kasai, by inoculation experiments on rats, mice and guinea pigs, and serological tests involving Pfeiffer's reaction, has concluded that the smaller spirochætal forms obtained from cases of rat-bite fever and the slightly larger forms occurring naturally in rats and mice are identical.

Hoffmann has not accepted the differentiation between *Spirochæta icterohæmorrhagiæ* and *Spirochæta icteroides.* The thorough investigation of the histological and hematological appearances in a large series of guinea pigs infected with *Leptospira icteroides* gave results absolutely identical with those found in another series of animals infected with *Leptospira icterohæmorrhagiæ,* and there were no clinical, pathological and anatomical differences in the two experimental infections, though attempts to differentiate these organisms by the immunity reactions were not included in this study.

Borges in a number of cases of yellow fever occurring in Bahia tested the serum with *Leptospira icteroides* by the Pfeiffer phenomenon and found negative results. However, Noguchi in a still more recent publication believes that these pathogenic *leptospira* are by no means identical, as can be proved not only by their immunological but also by their pathological properties. *Leptospira icteroides* is predominantly icteronephritic, with a marked tendency to produce fatty degeneration of the parenchymatous cells of the liver and kidney. The hemorrhages in mucous membranes are more pronounced in experimental infections with *Leptospira icteroides* than those resulting from *Leptospira icterohæmorrhagiæ*. He believes that the two diseases yellow fever and haemorrhagic jaundice are essentially similar, though caused by two distinct species of the genus *Leptospira,* just as syphilis, yaws and venereal disease of rabbits are three diseases caused by three morphologically indistinguishable species of the genus *Treponema.*

Among the many important advances that have recently been made in our knowledge of medical helminthology, and that have had an important influence in preventive medicine are the recent elucidations of the life-history of the trematodes *Schistosoma japonicum, hæmatobium* and *mansoni, Paragonimus westermanii* and *Clonorchis sinensis;* of *Dibothriocephalus latus* and *Spargonum mansoni;* of *Filaria (Loa) loa,* and of *Ascaris lumbricoides.* The schistosomidæ have been shown to be digenetic trematodes, and certain snails, particularly *bulinus* for *Schistosoma hæmatobium,* of *planorbis* for *Schistosoma mansoni* and *blandfordia* for *Schistosoma japonicum,* have been demonstrated to act as the intermediate hosts. The miracidia of these parasites hatch from the egg in water after entering these snails, develop into cercariæ which, being passed from the snail into the water, may infect man either through the normal skin as when bathing or through the mucous membranes as in drinking infected water. In the case of *paragonimus* there are two intermediate hosts, the first consisting of mollusks of the genus *Melania* in which the cercariæ are developed and from which they pass into the water and then either enter man directly or pass to the second intermediate host (the crustacean) consisting of species of crabs of the genus *Potamon* or *Eriocheir.* The cercariæ may migrate through the tissues of the crab and become discharged again into the water from the gills. Infection of man would appear to depend then not necessarily upon the consumption of uncooked crab or crawfish, but from the free larvæ which, while they can not penetrate normal skin, may enter from the water through the mucous membranes of man or through wounds in the skin. In the life-history of *clonorchis,* the two intermediate hosts have recently been shown to be the molluscan *Bythinia striatula,* from which the cercariæ pass to and encyst in edible fish, particularly *Pseudorasbora parva* and *Leucogobio guntheri,* man becoming infected from the ingestion of these fish. The life-cycle of *Loa loa* has very recently been worked out in two species of *Chrysops* in Nigeria, *Chrysops silacea* and *Chrysops dimidiata,* 358 flies experimentally infected having been examined by A. and S. Connal. Development takes place in the muscular and connective tissue, principally in the abdomen of the fly, but also in the thorax and head. The metamorphosis takes ten to twelve days for completion, and is somewhat similar to that of *Filaria bancrofti.*

Yosida has experimentally infested the dog and cat with larvæ of *Sparganum mansoni* of the species found both in the human body and the frog which it chooses as the final hosts. The larvæ belonging to both species developed into an adult worm, having a completely identical morphology. These parasites have often been found infesting dogs and cats, and ducks and chickens which eat frogs may also become infested. Human infection occurs from drinking water harboring the infected cyclops, or from eating insufficiently cooked infected chickens or ducks. Ransom in relation to the migration of the larvæ of *Ascaris lumbricoides* has called attention to the fact that a more or less serious lung trouble known as thumps is a very prevalent malady among pigs, and is caused primarily by *ascaris* larvæ in the lungs. He believes that pulmonary *ascaris* of a more or less severe form occurs also among human beings.

Of less importance, although of scientific interest, are the applications of serological methods involving the complement fixation test in the diagnosis of a number of trematode infections, particularly those due to *schistosomidæ, clonorchis* and *echinococcus* infection.

The efficacy of intravenous injections of tartar emetic in the treatment of bilharziasis, formerly considered incurable, has already been mentioned. Recently Lasky and Coleman have reported upon 1,000 cases of this disease treated with tartar emetic. Of 500 individuals who persevered with the treatment, which aimed to secure a cumulative effect from about twenty grains of tartar emetic, seventy per cent. were pronounced cured. Reference has also already been made to the toxicity of this drug, and in this series of cases there were ten deaths apparently due to the treatment, though many of the cases were stated to be physical wrecks at the time that the injections were commenced.

While the cercariæ of all the species of *schistosomidæ,* which have been demonstrated to be pathogenic for man and animals hitherto described, have been characterized by forked tails and no eye-spots, Tanabe has recently discovered in Boston a new species of *schistosoma, Schistosoma pathlocopticum,* pathogenic for mice, in which the cercariæ, while fork-tailed, have typical eye-spots. The cercariæ of this schistosome were first discovered in species of *Limnæa* collected from the Charles River near Boston.

A new anthelminthic known as butolan has recently been reported to be particularly efficacious in the prompt cure of oxuris infection and to produce no unfavorable symptoms. This substance is the carbamin-acid-ester of p-oxydiphenylmethane. In the body it breaks up into p-benzylphenol and carbamic acid. The former substance destroys the parasites.

Very interesting are the etiological problems in connection with a number of insect-borne diseases in which the causative organism, while present in the blood, is either of too minute size or in too scanty numbers for its recognition. In this connection I wish to refer briefly to such diseases as typhus fever, dengue fever, pappataci fever, trench fever, African horse sickness, heart-water of cattle, sheep and goats, and tsutsugamushi or kedani disease.

Although the method of transmission of typhus fever by the louse *Pediculus humanus* has been known from the experiments of Nicolle, Rickets, Wilder and others, since 1910, for a number of years the etiology of the disease has been very obscure. It has been possible to transmit the virus by inoculation of the human blood of a typhus patient into monkeys or guinea pigs and to convey it by blood inoculation through long series of these animals. The infection is not fatal in either the monkey or the guinea pig, and the only clinical indications that the infection is transmitted in this way in guinea pigs is by a transient rise in temperature, for these animals usually remain apparently well, continue to eat and act as though in a normal condition. However, if the animal is killed the diagnosis of the infection may be made, as Wolbach and Todd have recently shown, from the histological study of sections of the brain which will reveal the presence of proliferated vascular and perivascular lesions and meningeal infiltrations.

There had not been unanimity of opinion regarding the filterability of the typhus virus. Nicolle, Connor and Conseil inclined to the belief that the virus is filterable because monkeys that had been inoculated with filtrates of blood or of crushed lice that had harbored the virus, while showing no decided temperature reactions, had remained resistant to a subsequent infection of active virus.

Olitsky was unable to filter the virus either from the blood or through Berkefeld V and N candles from the disintegrated tissues of infected guinea pigs. Later, however, he found that in the filtrates of typhus infected tissues of guinea pigs, a substance was occasionally found which produces in these animals thermic reactions, lesions characteristic of experimental typhus, and less frequently immunity to later injections of active virus. However, evidence is given that the filtrates do not contain a living organism.

Recently Rocha-Lima, Topfer and Schuesler, Otto and Dietrich and others have discovered *rickettsia* in lice fed upon cases of typhus fever which occur particularly in the epithelial cells of the intestinal tract of these insects. Wolbach, Todd and Palfrey have also confirmed and greatly extended these investigations. In the meantime, experiments performed by Brumpt and by the writer had demonstrated that lice may be infected with species of *rickettsia* which are not pathogenic for man and that produce no symptoms when such lice are fed upon man. This work has subsequently been confirmed. Thus Noller found *rickettsia* in the louse tick *Melophagus ovinus* of sheep which produced no disease in these animals, and Arkwright, Atkin and Bacot showed that bedbugs, *Cimex lectularius,* heavily and commonly infected with *rickettsia,* produced no symptoms when fed on man.

Besides three species of *rickettsia* in *Pediculus humanus,* two of which have been regarded as pathogenic for man, other species not associated with any disease have been described as occurring in the bedbug *Cimex lectularius*, the mosquito *Culex pipiens*, in the cat flea *Ctenophalus felis*, the mouse flea *Ctenopsylaa musculi*, in the horse louse *Trichodectes pilosus* and the goat louse *Linognathus stenopsis*. Wolbach has also described as the cause of Rocky Mountain spotted fever an organism in the wood tick *Dermacentor venustus* which perhaps should be included in this group. Finally, during the present year, other species of *rickettsia* have been observed in the dove louse *Lipeurus baculus* and in *mallophaga*, the biting lice of the black martin and of the domestic fowl. While it is not entirely clear that all of these represent distinct species, it would nevertheless appear that the *rickettsia* represent a considerable group of microorganisms related to either the protozoa or bacteria, and that there is only evidence that two of these species are associated in any way with disease. In fact, the evidence shows that one species in the louse and one in the bedbug are not pathogenic for man.

Stevenson and Balfour, after studying the pathology of typhus fever, concluded that there were so many different species of *rickettsia* that they doubt as to their exact nature, let alone their pathological significance.

Phear, in reviewing recent work on the relationship of typhus to *rickettsia*, points out that the experimental evidence establishes a strong case in favor of the view that there is some association of a very close character between the virus of typhus and the *rickettsia* bodies, but, in considering the case for the identity of the two, that much depends on the nature of the granular structures which have been described in the vascular endothelium, and that the investigators would doubtless readily admit that confirmatory observations are necessary before the identity of the intracellular granules with the virus of the disease can be regarded as definitely established. Until an infection is actually produced by a pure culture of *rickettsia*, the etiological significance of these organisms will probably not be admitted by all scientific workers, but the recent work of Wolbach and Todd has gone far towards demonstrating the importance of *rickettsia* in human disease.

Several reports of the successful cultivation of *rickettsia* have been made. Kuczynski has cultivated *Rickettsia prowazeki* in modified blood plasma in celloidin capsules in the abdominal cavity of guinea pigs. The *rickettsia* of the sheep louse is said to grow on a relatively simple glucose blood agar medium. Loewe, Ritter and Baehr, during the past year, have reported upon the cultivation of *rickettsia* from the blood of typhus cases and from the brain and kidneys of guinea pigs, reacting to the blood from typhus fever patients. The media employed consisted in a rich ascitic fluid containing a fragment of sterile rabbit's or guinea pig's kidney and a small amount of two per cent. dextrose bouillon, the tubes being sealed with sterile petrolatum. Wolbach has also just announced the cultivation of *rickettsia* by the living tissue method. Bacot and Segal have shown that injections of lice with a concentrated emulsion of platelets obtained by fractional centrifugalization of the blood of a typhus infected guinea pig affords a sure and quick method of obtaining the development of *Rickettsia prowazeki* in these insects, which suggests under these conditions an association between blood platelets and the *rickettsia* bodies.

Considerable attention has very recently been attracted to the subject of mitochondria. While there is no evidence which would allow us to assume that they are parasitic, there is also as yet no decisive evidence of their significance and nature.

With reference to other cell inclusions recently described, particularly of the red blood cells of vertebrates, Mayer found in rats and in guinea pigs just recovered from a severe trypanosome infection numerous rods, like, but even smaller than, *bartonella*, and dumb-bell forms reminiscent of *rickettsia*, the blood picture being that of a grave anemia similar to that of Oroya fever. These forms he thought might possibly be regarded as degeneration changes or as an outburst of some latent infection. In the latter case, Mayer proposes under reservation the name of *Bartonella muris* for the inclusions. The question then arises whether in certain forms of pernicious anemia where inclusions of a similar nature occur, there may not be present some similar element of infection or excitation of infection.

Attempts to demonstrate microorganisms causing dengue fever have so far been unsuccessful. In 1903 a piroplasma was described as the cause of the disease. This observation has remained unconfirmed. The virus of the disease is believed to be filterable and the disease has been reproduced in man by the inoculation of filtrates of the blood in several cases. *Stegomyia fasciata* and possibly *Culex fatigans* are known to be the transmitting insects. Pappataci fever is also caused by a filterable virus or organism and is transmitted from man to man by *Phlebotomus papatassii.* Since the discovery by Noguchi that yellow fever is caused by *Leptospira icteroides,* which organism will also pass through a Berkefeld filter, it has been suggested that dengue fever and pappataci fever may also be due to a spirochæte, and in fact Couvy has reported that in an epidemic of this disease in Beirut, Syria, which attacked practically the whole population, direct examination of the blood showed the presence of short, slender spirochætes having two or three turns and fine extremities. These were only present when the blood was taken two or three hours before the onset of the fever, never during the course of the pyrexia or after the temperature had fallen. It is not stated whether the organisms were detected by dark-ground illumination or in fresh blood or in stained specimens. Neither has this observation been confirmed during the past year. The methods which led to the discovery of *rickettsia* in the transmitting insect of typhus fever have not yet been applied in connection with either dengue fever or pappataci fever, and no organism has yet been cultivated from the blood by Noguchi's method or on other media.

Trench fever is a disease which resembles dengue fever in a number of ways and yet is obviously quite a distinct infection. It is transmitted in nature by the louse, *Pediculus humanus.* The virus is present in the blood serum of infected individuals during the febrile stage of the disease, and the infection can be transmitted from man to man by the inoculation of such serum. Attempts to filter the virus through Chamberland filters from the blood have been unsuccessful, but under certain conditions it has been filtered from infected urine, and the disease has been reproduced by the inoculation of such filtrates. Certain experiments have been performed which also suggest that the disease may be caused by species of *rickettsia,* in that lice fed on trench fever cases have sometimes developed *rickettsia,* and that lice infected with *rickettsia* have sometimes given rise to trench fever when fed on healthy men. On the other hand lice not showing *rickettsia* have produced trench fever in man and the question has arisen as to whether the virus of typhus has not sometimes been confused with that of trench fever in certain experiments performed with lice. It has been suggested that trench fever is caused by a spirochæte, but it has not been possible to confirm this suggestion. When the cultivation of the *rickettsia* in vitro has been perfected, the inoculation of pure cultures of the species suggested as the cause of trench fever should shed further light upon the problem. It has been demonstrated that the virus of trench fever is very resistant in nature, and if it is of a similar nature to that of typhus fever there would probably be even less difficulty in cultivating it than the typhus virus.

Tsutsugamushi disease or Japanese river fever is an infection which has been proved to be conveyed by a minute red trombidium, *Leptus akamushi* Brumpt. This insect is an ectoparasite of field mice and freely attacks man in the endemic areas of the disease. Recent studies have shown that the virus is present in the blood and that it is not filterable. Nevertheless, it is suggested that it should be classified with the ultra-microscopic disease-producing organisms. Tsutsugamushi has some analogy to both typhus and Rocky Mountain spotted fever, but animals which have received an injection of the tsutsugamushi virus are still susceptible and react to an inoculation of the typhus virus and *vice versa.* The infection is transmissible to monkeys, in which it produces a febrile reaction, enlargement of the lymph nodes and a leucopœnia. The infection is sometimes fatal for the monkey. Guinea pigs are also said to be susceptible, but in these animals the virus produces only a slight temperature and an enlargement of the lymph nodes.

Miyashima has found small elliptical bodies in the larva and adult trombidium which could be cultivated in ascitic agar and when injected into monkeys produced the typical disease. Nagayo and others also found both in human cases and infected monkeys small organisms, oval or elliptical in shape, with a definite limiting membrane measuring 0.35 to 1 μ. In the endothelial cells of lymph glands their differentiation was difficult.

More recently Hayashi has found minute bodies described as rod, spheroid and ring-shaped in the lymphocytes of lymphnodes and in mononuclear endothelial phagocytes of the spleen and lymph nodes, and in the region of the bite in patients suffering from tsutsugamushi disease. These bodies also occur free in the blood plasma and in severe cases in the red cells. The parasite is said to resemble but show differences from *Bartonella bacilliformis* of Oroya fever and of *Theileria parva* of cattle anemia. For it the tentative name of *Theileria tsutsugamushi* has been proposed. Further confirmation of these observations is extremely desirable.

In more recent work by Kawanura and Yamaguchi no mention is made of the organism described by Hayashi as the causative agent. However, Ishimora and Ogata have found certain coccoid bodies 0.2 μ to 2.15 μ in size in sections made from the lymph glands, spleen and heart of cases of the disease and in the lesions of the testicles of monkeys experimentally infected with blood from human cases. These they were able to repeatedly cultivate in a special ascitic medium and from the cultures to infect monkeys. Megaw in referring to the typhus-like fevers carried by mites in different parts of the world suggests that tsutsugamushi disease is probably related to the sumatra typhus which is transmitted by a tick.

African horse sickness is a disease in which the virus is present in the blood plasma and from which it may be filtered through porcelain filters. It, however, will not pass through collodion sacks or through a layer of one per cent. agar. The virus loses its vitality at 50° C. and it is not destroyed by three per cent. carbolic acid, ten per cent. sodium taurocholate or ten per cent. saponin. A virus mixed with five to ten per cent. solution of lecethin fails to infect but it becomes virulent again when the two are separated. Drying at ordinary temperature destroys it. The virus can be transmitted experimentally by the inoculation of small amounts of the blood. The disease is probably transmitted from animal to animal naturally by the mosquito (*Ochlerotatus*). Ticks can also carry the virus but it has not been demonstrated that the bite of this insect transmits it. *Anopheles* and *Stegomyia* and *Stomoxys calcitrans* have also been shown to transmit the disease at least mechanically. In this connection it may be noted that sometimes the injection of .0001 c.c. of blood into a horse will convey the injection. The disease is not transmitted from animal to animal by contagion, or by feeding, unless the animal is given by the mouth 150 to 200 c.c of blood. Dogs, however, may become infected from eating the meat of infected horses. The disease disappears eight days after frost begins. The virus does not apparently survive in water, although it is fairly resistant. How the infection remains alive for from six to eight months between seasonal outbreaks still remains obscure. Swamp fever or the infectious anemia of horses is probably identical with African horse sickness, but the virus has entirely analogous relations with no other known virus. Whether it undergoes a special life-cycle in the transmitting insect similar to the malarial parasite, for example, is also unknown.

Heart-water disease of cattle, sheep and goats and catarrhal fever of sheep are somewhat analogous diseases, but there is some evidence to show that the viruses causing these diseases are not identical with that of African horse sickness.

Tularæmia has been described recently by Francis as a specific infectious febrile disease due to *Bacterium tularense*, and transmitted from rodents to man by the bite of an infected blood-sucking insect or by handling and dissection of infected rodents. Clinically, the onset of the disease is sudden, with headache, backache, pains in the limbs, lassitude and fever. In cases observed in Utah there was enlargement of the lymph glands which drained the areas surrounding the point of infection and a septic fever lasting from three to six weeks. The site of the insect bite and the adjacent lymph glands became tender and inflamed and they commonly suppurated. The rodents found infected in nature are the California ground squirrel, *Citellus beecheyi*, the ground squirrel of Utah, *Citellus mollis*, the rabbits of southern Indiana and the jack-rabbits of Utah. The insects shown to be capable of transmitting the infection are *Chrysops discalis, Stomoxys calcitrans, Ceratophylis acutus, Cimex lectularius, Polyplax serratus* and *Hæmodipsus ventricosus.* The first four of these insects bite both rodents and man. Infection probably occurs most commonly through the bite of *Chrysops discalis.* The bacillus causing the disease is a very minute organism and can best be cultivated upon egg-yolk media, but no growth is obtained on ordinary nutrient agar. The organism produces a plague-like disease in rodents, and in fatal guinea pig infections the gross lesions can not be distinguished from those produced by *B. pestis.* The pathological histology of the lesions caused by *B. tularense,* as shown by Councilman and the writer, are, however, quite different. In the lymph-nodes, liver and spleen, there are miliary foci formed by accumulation of mononuclear cells followed by necrosis and infiltration with polymorphonuclear leucocytes. There is a general infection of the endothelium of the blood vessels and the organism may be found in these cells in any part of the body. In addition the organisms pass from the endothelium into the cells of the liver, which they gradually destroy and replace, forming large globular masses of bacilli. The infection of the endothelial cells presents a somewhat similar picture to that seen in typhus fever but not in any other disease where these cells are distended with *rickettsia.*

It is hoped that this article will in some degree serve to emphasize the important position which the subjects of medical zoology, entomology and parasitology have recently taken in connection with general progress in medical science, and the fact that they are subjects which have important practical application in preventive medicine; that they constitute adjuncts to hygiene which have been most successfully prosecuted in tropical countries but which can not be wisely neglected in any country; that by the more thorough and fundamental training of medical men in these branches still greater progress in the elucidation of the many and perplexing problems connected with the etiology, prevention and control of the infectious diseases more common in temperate climates may be expected. Finally, it is hoped that it will not only indicate the most important recent progress in the fields of science referred to, but that it will also serve to some extent to stimulate and guide research in a few of those channels in which further knowledge is urgently needed.

RICHARD P. STRONG
SCHOOL OF TROPICAL MEDICINE,
HARVARD UNIVERSITY

EXTRACTS FROM ESSAYS OF LEONARDO DA VINCI

LOOKING over the translation of "Leonardo da Vinci's Notebooks" by Edward McCurdy (Scribners), I was reminded of the high praise awarded the great artist-engineer in Lyell's "Principles of Geology." Priests and scholars in da Vinci's day were wrangling over the origin of fossils. Were they forms or models produced in the fatty matter (*materia pinguis*) of the earth by the revolution of the stars? Were they relics of Noah's flood; were they, as Voltaire suggested, cockle-shells; were they dropped from pilgrims' hats during the crusade?

In these notebooks, from which I give here a brief extract, Vinci makes the whole matter perfectly clear, for he was a close observer and a skilful engineer, qualities rare in that age of fine painting and loose thinking. If men had listened, it would not have taken 150 years to prove that fossils had once been alive, and another 150 to prove that they were not all buried simultaneously in the great flood.

DAVID STARR JORDAN
STANFORD UNIVERSITY,
APRIL 6, 1923

Defense of Fossil Shells as Once Living Organisms

As for those who say that the shells are found over a wide area and produced at a distance from the sea by the nature of the locality and the disposition of the heavens which moves and influences the place to such a creation of animal life,—to them it may be answered that, granted such an influence over these animals, they could not happen all in one line, save in the case of those of the same species and age; and not one old and another young, one with an outer covering and another without, one broken and another whole, nor one filled with sea sand, and the fragments great and small of others inside the whole shells which stand gaping open; nor the claws of crabs without the rest of their bodies; nor with the shells of other species fastened on to them, like animals on the outside where it has eaten its way like a worm in wood; nor would there be found among them bones and teeth of fish which some call arrows, other serpents' tongues; nor would so many parts of different animals be found joined together, unless they had been thrown up there upon the borders of the sea.

And the Flood could not have carried them there, because things which are heavier than water do not float high in the water, and the aforesaid things could not be at such heights unless they had been carried there floating on the waves, and that is impossible on account of their weight.

Where the valleys have never been covered by the salt waters of the sea, there the shells are never found.

Such things are far more ancient than letters, it is not to be wondered at if in our days there exists no record of how the aforesaid seas extended over so many countries; and if moreover such record ever existed, the wars, the conflagrations, the deluges of waters, the changes in speech and habits have destroyed every vestige of the past. But sufficient for us is the testimony of things produced in the salt waters and now found again in the high mountains far from the seas.

Apostrophe to a Huge Fossil Fish, Sword Fish or Tunny

O powerful and once living instrument of constructive nature, thy strength not availing thee, thou must needs abandon thy tranquil life to obey the law which God and time ordained for all procreative nature! To thee availed not the branching, sturdy, dorsal fins wherewith pursuing thy prey thou wert wont to plough thy way, tempestuously tearing open the briny waves with thy breast.

O how many times the frightened shoals of dolphins and big tunny fish were seen to flee before thy insensate fury; and thou, lashing with swift, branching fins and forked tail, didst create in the sea mist and sudden tempest, with loud uproar and foundering of ships; with mighty wave thou didst heap up the open shores with the frightened and terrified fishes, which thus escaping from thee were left high and dry when the sea abandoned them, and became the plenteous and abundant spoil of the neighboring peoples.

* * * * *

O time, swift despoiler of created things! How many kings, how many people hast thou brought low! How many changes of state and circumstances have followed since the wondrous form of this fish died here in this hollow, winding recess? Now destroyed by time patiently thou liest within this narrow space, and with thy bones despoiled and bare are become an armour and support to the mountain which lies above thee.

O how many times hast thou been seen amid the waves of the mighty, swelling ocean, towering like a mountain, conquering and overcoming them! And with black finned back ploughing through the salt waves with proud and stately bearing!

SCIENTIFIC EVENTS

OXFORD MEMORIAL TO SIR WILLIAM OSLER

AT the final meeting of the subscribers to the Oxford Osler Memorial Fund held at the University Museum, Oxford, Sir Herbert Warren, president of Magdalen College, chairman of the executive committee, explained in a brief introduction that the Oxford Memorial was only one of several, the United States of America and Canada, in which Sir William had spent a larger part of his life, having decided to establish memorials of their own.

The secretary, Dr. J. A. Gunn, stated that the fund now amounted to just short of £2,000. The following proposals were submitted on behalf of the executive committee:

(1) The purchase of a bronze plaque of Sir William Osler, measuring 32 by 22 inches, a copy of that by Vernon of Paris, made for the Medical Faculty of Maryland, to be hung in the university museum; (2) the establishment of a fund for the foundation of an Osler Memorial Medal in bronze, to be awarded every five years to a graduate of the University of Oxford who has made some distinguished contribution to medical science, learn-

ing or practice. This medal might be a reduced replica of the portrait plaque; (3) the remainder of the sum, together with any sums hereinafter added, to be called the "Osler Traveling Fund," for the propagation or acquisition of medical knowledge or for medical research, to be invested and the interest utilized to assist teachers of the medical faculty to travel for the purposes stated. It is estimated that the capital sum remaining for this purpose will be about £1,700.

Sir Archibald Garrod, regius professor of medicine, in introducing these proposals, stated that they had the entire approval of Lady Osler, as well as of other friends from whom letters had been received. They were supported by Surgeon-Major-General Sir Frederick Bradshaw and adopted *nem. con.* and the executive committee, which consists of Sir Herbert Warren, Sir Archibald Garrod, Sir Charles Sherrington, Professor Arthur Thomson, Mr. A. P. Dodds Parker, honorable treasurer, and Professor J. A. Gunn, honorable secretary, were empowered to take steps to carry them into effect, and, in particular, to negotiate any arrangements with the university which may be found desirable.

THE COMMITTEE OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE ON PHOTOSYNTHESIS

THE Committee of the American Association for the Advancement of Science on Photosynthesis which was authorized at the Boston meeting following the notable symposium on this subject has recently completed its organization by the acceptance of the following persons as members:

Dr. C. G. Abbot, assistant secretary Smithsonian Institution.

Dr. F. G. Cottrell, director Fixed Nitrogen, Research Laboratory, Washington.

Dr. Moses Gomberg, Department of Chemistry, University of Michigan.

Dr. W. J. Humphreys, meteorological physicist, United States Weather Bureau, Washington, D. C.

Dr. D. T. MacDougal, director Department of Botanical Research, Carnegie Institution of Washington, *chairman*.

Dr. S. E. Sheppard, in charge of Department of Physical Chemistry, Research Laboratory, Eastman Kodak Company, *secretary*, Rochester, N. Y.

Dr. E. E. Slosson, director of Science Service, Washington.

Dr. H. A. Spoehr, member, Department Botanical Research, Carnegie Institution of Washington.

The preliminary activities of the committee will be directed chiefly to bringing together information as to current researches being carried on in various laboratories, and to serve as a focus of interest in the subject. Arrangements are being made for some special lectures on the subject. Attention will be given to the matter of obtaining funds and facilities in the furtherance of research on various phases of the subject.

EXPEDITION TO THE HAWAIIAN ISLANDS

THE Bureau of Biological Survey of the United States Department of Agriculture, in cooperation with the Bishop Museum of Honolulu, began on April 4 a comprehensive scientific survey of the islands of the Hawaiian archipelago, from Niihau to Midway and Wake.

The objects of this expedition are two fold: first, to make a much needed survey of the Hawaiian Island bird reservations to ascertain the situation as to the bird life of these great breeding places for sea-fowl, and, second, to take advantage of the opportunity to make a comprehensive scientific survey of the islands visited. This last will make a contribution to the general survey of the islands of the Pacific, now being promoted by the Bishop Museum. The National Research Council, in furtherance of its policy to promote the investigation of the resources of the Pacific, has made a grant of funds to assist the expedition.

Dr. Alexander Wetmore, of the Bureau of Biological Survey, is in charge of the expedition, and took with him as field assistant Charles E. Reno, of the same bureau. The expedition, in addition, is made up of a corps of scientists from the Bishop Museum, led by the director, Dr. Herbert E. Gregory. These include S. C. Ball, curator of biology; D. T. Fullaway, entomologist; E. L. Caum, botanist; D. Thaanum, conchologist; C. Grant, general assistant, and J. W. Thompson, preparator. Mr. Donald R. Dickey, of Pasadena, California, accompanies the expedition as photographer, to secure motion pictures of the noteworthy colonies of sea birds found on Laysan Island.

One object of the expedition is to exterminate the rabbits on Laysan, where at least two European species introduced by a guano company have increased to such an extent as to endanger the continued existence of the vegetation, and indirectly, that of several species of birds inhabiting the reservation.

Through the courtesy and interest of Secretary Denby and Assistant Secretary Roosevelt, of the Navy Department, a vessel has been placed at the disposal of this party for a period of four months. Plans have been made for this boat to return once a month to Honolulu in order that the work of the expedition may be more effectively accomplished and to enable a number of scientists to participate who otherwise could not do so.

E. W. NELSON
Chief, Biological Survey

APRIL 26, 1923

THE INDIANA ACADEMY OF SCIENCE

THE Indiana Academy of Science will hold its spring meeting and field excursion at Brookville, Indiana, on May 10, 11 and 12, 1923. This meeting is somewhat of the nature of a tribute to Dr. Amos W. Butler, one of the founders of the academy. Dr. Butler has just resigned his position as secretary of the Indiana State Board of Charities after twenty-five years of distinguished service. In 1881 he organized the Brookville Natural History Society and four years later, largely through his suggestion and efforts, this society was transformed into the Indiana Academy of Science. Dr. David Starr Jordan was the first president of the academy and on May 20, 1886, the first field meeting was held at Brookville. That night at a public meeting Dr. Jordan delivered an address on "Charles Darwin."

The program includes a public meeting to which citizens of Brookville are invited. Brief addresses will be delivered, as follows:

(1) Brookville and its contribution to the intellectual life of the state: John C. Shirk.

(2) The geologic aspects of Brookville and vicinity: D. R. Moore.

(3) Changes in Indiana flora: Stanley Coulter.

(4) Some reminiscences of early academy days: Amos W. Butler.

A day will be spent in a field excursion to various points along the Whitewater River, or one of its tributaries. This section of the country is one of the most picturesque in Indiana. The town of Brookville is located at the junction of two branches of the Whitewater and flanked by lofty hills. There will be ample opportunity to study the natural history of the region and to discuss them at the informal meetings.

Scientists from neighboring states are invited to attend this meeting.

HARRY F. DIETZ
Press Secretary

AMERICAN SCHOOL IN FRANCE FOR PREHISTORIC STUDIES

IN entering upon the third year of its activities, the school invites the affiliation of capable graduate students of either sex who may wish to avail themselves of the opportunities that are offered.

The object of the school is to give the American student of man's antiquity and evolution and old world archeology sound first-hand knowledge in these lines under capable and experienced leadership.

The two first years of the school were devoted principally to instruction in the museums of France and to careful excavations on one of the sites of early man in that country, namely, La Quina. The work of the third year will differ in a measure. Its object will be first to acquaint the students directly with all the important sites and remains of early man in western Europe, and to engage in actual excavations only after the students have received a good foundation in the subject.

The work will commence on July 1 in London, and it will comprise on the one hand the study of the original specimens relating to early man in the various museums of England, France, Belgium, Germany, Czechoslovakia, Croatia, Austria and Switzerland, and on the other, visits to such important sites as the Piltdown, La Quina, Dordogne, Mauer, Ehringsdorf, Brno, Krapina and others as far as time will permit. Following this a site in France will be chosen where careful methods of excavation may be taught and practised; and when field-work becomes impossible the students desirous of staying abroad will be helped to opportunities for further studies. The months of July and August, with probably a part of September, will be spent in visits to the various sites and museums; the rest of September and October will be devoted to field work in France; and for the winter months arrangements will be made in Paris or elsewhere according to the best interests of the students.

The conditions of affiliation with the school on the part of the students are good health and character, proper introduction, serious purpose and a spirit of earnest cooperation with the director. The students may be accepted for three, six, nine or twelve months. They pay nothing to the school or for field work, but defray all their personal expenses. To reduce the latter and facilitate matters in general, the students will elect among themselves a committee which will see to transportation, accommodation and other things concerning the whole group. Upon the completion of their course, deserving students will be given a suitable certificate by the school.

Applications should be sent to the director before May 30 at the latest. The participants will need to make steamship reservations well in advance and allow plenty of time for obtaining their passports and visés.

Aleš Hrdlička
Director, 1923-24

U. S. National Museum,
Washington, D. C.

SCIENTIFIC NOTES AND NEWS

At the meeting of the National Academy of Sciences held in Washington on April 25 Dr. A. A. Michelson, professor of physics in the University of Chicago, was elected president in succession to Dr. Charles D. Walcott, secretary of the Smithsonian Institution. Dr. J. C. Merriam, president of the Carnegie Institution of Washington, was elected vice-president in succession to Dr. Michelson. Dr. David White, of the United States Geological Survey, was elected secretary to succeed Dr. C. G. Abbot, assistant secretary of the Smithsonian Institution and director of the Astrophysical Observatory. Professor R. A. Millikan, of the California Institute of Technology, continues as foreign secretary and Dr. F. L. Ransome, as treasurer.

The following men of science have been elected to membership in the National Academy of Sciences: Solon Irving Bailey, Harvard Observatory; James Henry Breasted, University of Chicago; Ernest William Brown, Yale University; Carl H. Eigenmann, University of Indiana; Yandell Henderson, Yale University; Marshall Avery Howe, New York Botanical Garden; Max Mason, University of Wisconsin; Elmer Drew Merrill, Bureau of Science, Manila; Eugene Lindsay Opie, Washington University, St. Louis; Leonhard Stejneger, United States National Museum; George Fillmore Swain, Harvard University; Richard Chace Tolman, California Institute of Technology; David Locke Webster, Stanford University; Frederick Eugene Wright, Geophysical Laboratory of the Carnegie Institution; Robert Mearns Yerkes, National Research Council.

At the meeting of the American Philosophical Society on April 21, the following were elected to membership: Frank Aydelotte, Swarthmore; Edward Asahel Birge, Madison; Isaiah Bowman, New York; Carl Darling Buck, Chicago; Karl E. Compton, Princeton; Herbert Ernest Gregory, New Haven; Charles Downer Hazen, New York; Phoebus A. Levene, New York; George Perkins Merrill, Washington; Samuel Alfred Mitchell, Charlottesville; Richard Bishop Moore, Washington; William John Sinclair, Princeton; Vilhjálmur Stefánsson, New York; Rodney H. True, Philadelphia; Thomas Wayland Vaughan, Washington.

A citation for the award of a distinguished service medal to Dr. Harvey Cushing of Boston has been approved by Secretary of War Weeks. The citation refers to Dr. Cushing as senior consultant of surgery of the American Expeditionary Forces and in direct charge of treatment of gunshot wounds of the First Army Hospital during the Meuse-Argonne offensive and says: "He performed conspicuous and distinguished services to the government" and "his individual efforts in that capacity saved the lives of many severely wounded soldiers."

Awards of the Royal Geographical Society have been made as follows: The Founder's Medal to Mr. Knud Rasmussen for his exploration and research in the Arctic regions during the last twenty-five years. The Patron's Medal to the Hon. Miles Staniforth Cater

Smith, for his explorations in the unknown interior of Papua. The Murchison Grant to Captain A. G. Stigand, for his map of Ngamiland. The Back Grant to Mr. B. Glanvill Corney, for his studies in the historical geography of the Pacific. The Cuthbert Peek Grant to Messrs. R. A. Frazer and N. E. Odell, to assist them in continuing their explorations of Spitsbergen. The Gill Memorial to Captain Augiéros for his journey in 1920-1921 from Algiers to Mauritania.

THE Hansen prize for distinguished microbiological work has been awarded this year by the committee of Danish trustees to Dr. E. J. Allen, director of the Marine Biological Association's laboratory at Plymouth.

DR. HUGH M. SMITH, formerly commissioner of fisheries, has been appointed fisheries adviser of the Siamese government. Dr. Smith is sailing for Bangkok by way of San Francisco and Honolulu.

N. H. DARTON has returned to his office in the United States Geological Survey after an absence of nearly two years completing the field work on the geologic map of Arizona. The University of Arizona recently conferred on Mr. Darton the honorary degree of doctor of science in "recognition of his investigations on the geology of the Southwest."

THE first award of the Mary Ellis Bell Prize for the best undergraduate work in medical research at the University of Pennsylvania was made to Messrs. J. B. Barnwell and R. Lynch for their work on transplantation of islet tissue. This work was presented at the fifteenth annual meeting of the Undergraduate Medical Association on April 19.

PROFESSOR T. H. PARDO DE TAVERA, of the University of the Philippines, has been appointed director of the Philippine library and museum.

DR. VICTOR F. HESS, chief physicist of the United States Radium Corporation, has resigned in order to return to the University of Graz, where he holds the chair of experimental physics.

PROFESSOR GEORGE C. WHIPPLE, of Harvard University, has resigned from the Public Health Council of the Massachusetts State Department of Public Health in order that he may have more time for his teaching and for his private practice. Professor Whipple was recently elected president of the Anti-mosquito Association of Massachusetts.

PROFESSOR SUTHERLAND SIMPSON, of the Ithaca Branch of the Cornell University Medical College, will leave late in May to attend the eleventh international physiological congress at Edinburgh and will spend the rest of his sabbatic leave in Denmark, Holland, France and Belgium, returning to Ithaca for the second term of the next academic year.

DR. WALTER W. KING, surgeon, United States Public Health Service, Washington, has been directed to proceed to Hull, England, to attend the Congress of the Royal Sanitary Institute, beginning on July 30.

SIR HAROLD JALLAND STILES, professor of surgery at the University of Edinburgh and former president of the Association of Surgeons of Great Britain and Ireland, occupied the chair of Dr. Harvey Cushing of Harvard University, Boston, for one week during April; he then spent a week at the Johns Hopkins University, Baltimore.

THE *Journal* of the American Medical Association writes: "In 1919, the American Association of Pathologists and Bacteriologists presented to Dr. Harold C. Ernst, Boston, a gold headed cane, a token of appreciation of his services to the association and to medicine. Before his death, in 1922, Dr. Ernst conceived the idea of using the cane as a sign of approval of the work of those who represent the best traditions in medicine. The council of the association will, therefore, confer custodianship of this token from time to time, such custodianship to last throughout the recipient's lifetime. It was unanimously voted this year to confer the custody of the cane on Dr. William H. Welch, of Baltimore, who has accepted the honor. Dr. Welch will prepare a manuscript on his experiences in medicine, to maintain the historical significance of the cane."

THE formal opening of the laboratories of the Philadelphia Research Institute of Cutaneous Medicine was held on April 26, with Dr. David Riesman presiding. Dr. Udo J. Wile, of the University of Michigan, gave the opening address. Dr. Jay Frank Schamberg is director of the institute.

DR. OTTO MEYERHOF, professor of physiology in the University of Kiel, as a guest of the department of physiology of Washington University School of Medicine, lectured on the "Dynamics of muscles" and the "Energetics of cell processes" on April 17 and 18.

PROFESSOR HERMAN L. FAIRCHILD, emeritus professor of geology in the University of Rochester, was the speaker at the weekly luncheon of the Cornell Club of Rochester on March 14. His subject was "The conservation of the water supply in New York state."

ON March 29 to 31, Dr. T. Wayland Vaughan, of the United States Geological Survey, gave a series of five lectures on the origin of limestone and coral, coral reefs and coral reef regions before the faculty and advanced students of the department of geology of the University of Wisconsin.

THE May lecture of the Institute of Metals for the present year was delivered by Dr. W. Rosenhain on May 2. The subject was "The inner structure of alloys."

A MEETING was held at Columbia University on April 24 to commemorate the four hundred and fiftieth anniversary of the birth of Copernicus. Addresses were delivered by President Nicholas Murray Butler, Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, and Ladislas Wroblewski, Polish minister to the United States.

THE Paris correspondent of the *Journal* of the American Medical Association writes: "The government, desirous of encouraging all movements connected with the commemoration of Pasteur and deeming it advantageous to offer all the elements of the population an opportunity to participate, has authorized a tag day in honor of Pasteur. It will not be the sole purpose of this manifestation to exalt the memory of one of the most eminent French scientists. Of equal importance will be the endeavor to awaken public opinion in support of a widespread movement in favor of the development of scientific laboratories and the improvement of the various material resources placed at the disposal of our men of science for the carrying out of their researches. A circular letter expressing this idea has been sent to the prefects by the minister of the interior. May 27 has been chosen for the tag day. The proceeds will be used for the benefit of scientific laboratories."

MR. EDMUND F. DICKINS, hydrographic and geodetic engineer in the United States Coast and Geodetic Survey since 1869, died at San Francisco, California, March 2, in the seventy-ninth year of his age, after a service of fifty-one years. He had been retired from active duty since 1920. He was director of coast surveys in the Philippine Islands from 1908 to 1911 and had held many other important assignments.

DR. JOHN VENN, president of Caius College, Cambridge, distinguished for his work on logic and later for his archeological researches, died on April 4, in his eighty-ninth year.

DR. CHARLES EMMANUEL FORSYTH MAJOR, F. R. S., known for his work in paleontology, died on March 25, aged seventy-nine years.

ERNEST WATSON VREDENBURG, known for his work on the paleontology of India, died on March 12, aged fifty-three years.

A CORRESPONDENT writes: News has been received of the death on April 11, at Cringleford, Norwich, of Frederick William Harmer, father of the director of the British Museum (Natural History), in his eighty-eighth year. A fellow of the Geological Society and long interested in the Pliocene of Britain, he was active until the very last, completing just before his death the last plate of his important "Monograph of the British pliocene mollusca" which has been in process of publication since 1914 by the Paleontographical Society. This work for future students will take the place long occupied by the classical monograph of the Crag Mollusca, by Searles Wood, and constitutes a permanent memorial of its venerable author.

THE meeting of the French Association for the Advancement of Science will be held this summer at Bordeaux.

THE department of geology, United States National Museum, has received as a gift from Dr. Frank Springer the paleontological collections of the late Orestes H. St. John. The collection contains a large and valuable series of Selachian fishes including many type specimens, the most notable of these being a specimen from the coal measures of Kansas, containing the complete dentition of a large shark of paleozoic time.

DR. BRUNO GALLI VALERIO, professor at the Lausanne University, proposes to erect a meteorological observatory and a scientific research station on the top of the Rochers de Naye (6,473 ft.) above Montreux.

PRESIDENT MARION L. BURTON, of the University of Michigan, has received a letter from Carl Guthe, who is conducting an archeological expedition of Michigan men in the Philippines, in which the writer tells of the success of the expedition. More than 100 caves have been uncovered by the excavators in which were discovered many ancient implements and other remnants of an extinct civilization. The party is carrying on the expedition through the generosity of a Detroit alumnus, who provided anonymously $30,000 for the expenses of the expedition.

THE London *Times* reports that a number of German professors and officials have issued Easter appeals for monetary assistance on behalf of their various institutes. Professor Einstein, who appeals on behalf of the Kaiser Wilhelm Institute for Physics, states that the income of the institute before the war was 75,000 marks (then worth £3,750). It is now about 22,000,000 marks, which is worth about £225. Appeals are made also for the Cancer Research Institute, the Botanical Gardens and other institutions.

HIRAM PERCY MAXIM, president of the American Radio Relay League, will confer with Donald B. MacMillan, polar explorer, to make arrangements to send an amateur radio operator of the league to the polar regions on MacMillan's expedition next June. It will be the first time that a polar expedition will be in regular communication with the amateur radio operators of the country. The operator will be selected from 12,000 league members by questionnaires, which are being sent to amateur operators in all parts of the United States. Mr. MacMillan will make the selection.

UNIVERSITY AND EDUCATIONAL NOTES

THE $2,000,000 endowment fund for the Henry Phipps Psychiatric Clinic at the Johns Hopkins University has been completed.

PLANS have been completed for the establishing of a $500,000 maternity hospital with the Washington University School of Medicine group. This hospital will be an eight story building and will eventually have a two hundred and fifty bed capacity instead of the thirty-three bed capacity of the present St. Louis Maternity Hospital, which it will succeed. It will have a similar affiliation with the medical school as the St. Louis Children's, the Shriners' Hospital for Crippled Children and the Barnes Hospital now hold. Ground will be broken within the next six months.

GOVERNOR SMITH has vetoed the appropriation of $830,000 for a new plant industry building for the New York College of Agriculture at Cornell University with the explanation that a special bill would later carry a larger sum, in accordance with new estimates made by the state architect.

WITHROW MORSE, Ph.D. (Columbia) has been elected to the chair of physiological chemistry and toxicology in the Jefferson Medical College, Philadelphia. Dr. Morse is at present professor of physiological chemistry in the school of medicine of the West Virginia University.

PRESIDENT WALLACE W. ATWOOD announces a number of additions to the faculty of Clark University, including, for one year, Dr. J. F. Neirmeyer, rector of the University of Utrecht, Holland, economic geography; Dr. Oliver Edwin Baker of the United States Department of Agriculture, professor of agricultural geography; Dr. Alfred L. P. Dennis, professor of modern history; Clarence Fielden Jones, M.S., assistant professor of economic geography; Ellen Church Temple, acting professor of anthropo-geography; William L. Langer, assistant professor of European history; Douglas C. Ridgeley, professor lecturer in geography.

THE resignations from Clark University are announced of Dr. Harry E. Barnes, professor of the history of thought and culture, and Robert C. Dexter, professor of social science. Dr. Barnes has accepted a position in the sociological department at Smith College. Mr. Dexter will become head of the department of sociology at Skidmore College.

Dr. Frederick G. Banting, Toronto, will be appointed to a chair in medicine at the University of Toronto if plans of the university and the provincial government materialize. An annual allowance of $10,000 accompanies the appointment, $6,000 being for salary and the remainder for supplies, assistants and other expenses.

DISCUSSION AND CORRESPONDENCE

CONCENTRATIONS OF IONS OF INSOLUBLE OR UNDISSOCIATED SALTS IN SOLUTION

Professor Rodebush in his recent comment[1] on a note by the writer on the mode of reaction of slightly soluble salts[2] has pointed out the improbability of the existence of a statistical equilibrium in a solution with only one ion or even less per liter. Since, as a result of the work of Gibbs and Boltzmann, entropy and thermodynamic equilibrium are considered to be statistical phenomena, it follows that when a statistical equilibrium is improbable, a thermodynamic equilibrium is likewise so. As a matter of fact, the concentrations of cathions of insoluble sulphides or complex ions obtained by calculation from E. M. F. measurements are of such a magnitude as to exclude thermodynamic equilibrium which is the fundamental assumption underlying such a calculation.

It is very questionable whether Knox's[3] calculations of the solubilities of the sulphides based on E. M. F. measurements should be taken literally. That these calculations are not always valid may be seen from the fact that while Knox gives a value of 2.6×10^{-15} for the solubility product of PbS, Noyes and Bray[4] find by precipitation methods a value of at least 1.8×10^{-22} and Stieglitz[5] believes that 2×10^{-27} is not low enough.

One of two possibilities suggests itself: either there is a sufficient concentration of ions in the solutions of the insoluble substances to make possible a thermodynamic equilibrium and that the resulting E. M. F. is not indicative of the actual ionic concentration, but rather of the effectiveness of the concentration present as compared to that of a solution containing one mole of ions per liter; or there is no thermodynamic equilibrium and the E. M. F. is not the result of an equilibrium between the electrode and the particular ions in solution. From the agreement in the degree of insolubility of the series of sulphides as found by E. M. F. measurements and by precipitation methods, it would seem that we may assume the first alternative to be the correct one and as another instance of the unreliability of calculations from such measurements at low concentrations.

Benjamin S. Neuhausen

Johns Hopkins Medical School

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[1] Science, N. S., lvii, 358, 1923.

[2] *Ibid*, lvii, 26, 1923.

[3] *Trans. Faraday Soc.*, iv, 44, 1900.

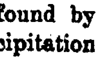
[4] *J. Amer. Chem. Soc.*, xxix, 137, 1907.

[5] Qual. Chem. Analysis, Vol. I, p. 212, 1916 edition.

AN EGYPTIAN MATHEMATICAL PAPYRUS IN MOSCOW

In an article[1] which appeared in 1917, Mr. B. Touraeff gives an account of a mathematical papyrus of the late middle empire, now in the Museum of Fine Arts in Moscow.

The translation of probably the most important new problem, giving the volume of a truncated pyramid, is as follows:

"The problem is to make a . If it be said: '. . . 4 below, 2 above,' do as follows: square this 4, which gives 16; duplicate 4, which gives 8. Do as follows: square the 2, which gives 4. Add the 16 to the 8 and the 4, which gives 28. Do as follows: take one third of 6, which gives 2. Do as follows: take 28 twice, which gives 56. This is the 56. You will find it correct."

This is precisely following the formula which we would use to calculate the volume of a truncated square pyramid with upper base 4 on a side, with lower base 2 on a side, and with altitude 6.

The remarkable appearance of this formula is paralleled by the use of somewhat analogous formulas in finding the sum of a geometric series and in solving problems in arithmetical series in the Ahmes papyrus[2] which antedates by one hundred or more years the recently famous King Tut-ankh-amen.

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[1] "The volume of the truncated pyramid in Egyptian mathematics," Ancient Egypt, 1917, pp. 100-102.

Another problem in the Moscow papyrus is concerned with determining the "sides of a quadrilateral, when the relation of the sides and the area of the quadrilateral are known." This problem is almost equally important, as it indicates clearly the Egyptian inspiration of a whole series of problems found in Euclid's Data. The problems in question are concerned with the determination of the sides of a rectangle when the area and some other relationship of the sides are given.[3]

Louis C. Karpinski

University of Michigan

ZIRCONIUM FRACTIONS

A communication by Professor Kurt A. Grönvall in *Svensk Kem. Tids.* for April may be of interest to some of your readers. Professor Grönvall has been reading some back numbers of his *Zeit. für Kristallographie* and came across references to zirconium fractions which led their observers to all the thrills of discoverers of new elements. These supposedly new elements were observed before Nils Bohr came upon the scene with a new fangled tool and could not therefore be clinched as was hafnium. The elements from zirconium are: ostranium discovered by Breithaupt of Freiburg in 1825, noranium by Svanberg of Uppsala, discovered in 1845, and jargonium by the first petrographer, H. C. Sorby, from zirconium collected in Ceylon, 1869. Now comes hafnium with its several discoverers. Professor Grönvall asks us, "Is hafnium a new element?"

Anton R. Rose

Edgewater, N. J.
April 22, 1923

QUOTATIONS

FEDERATIONS OF SCIENTIFIC MEN

The reluctance to discuss the monetary value of their services is a tradition which dies hard among the brain-workers in this country and abroad, and is in large measure responsible for the unenviable position of many salaried workers during and since the war. In the legal and medical professions, which occupy a legalized privileged position and are further safeguarded by the needs and the attitude of the community, professional unity is possible and demands for improved conditions of service and better remuneration for these classes are generally successful. The success of medical men in this country in particular has given an impetus to other professional workers towards combination, and various organizations now exist having for their avowed object the improvement of the economic position of the professional classes. In France, after approaching first the Confédération Générale du Travail, and later the General Association of Employees—both organizations of manual workers—the brain-workers have decided to form their own independent Confédération des Travailleurs Intellectuels. It is already in a position to exert considerable influence in the chamber of deputies and the senate, and its success has provoked the creation of similar bodies in several other European countries. In this country there is an organization, the National Federation of Professional, Technical, Administrative and Supervisory Workers, founded in 1920, having similar aims. Hitherto it has not been able to obtain the support of the medical, legal, engineering, teaching or scientific associations. These may join the federation later, but, in the first instance, they will probably find it better to form their own federation. The time is certainly opportune for a movement to be made in this direction.—*Nature.*

THE INTERNATIONAL WORK OF SCIENTIFIC SYNTHESIS[1]

The current development of science is so varied and so extensive that even the expert is finding difficulty in keeping in touch with the detailed acquisitions not merely in his own field but often also in those divisions of it to which his own labors are devoted. This has become so pronounced that one sometimes hears the fear expressed that the body of science is in danger of falling apart into chaos from its mere bigness and diversity. It is often true that experts in the same field can not understand the details of each other's work well enough to judge its value with any confidence; and the different sciences have adopted each a jargon peculiar to itself so that workers from different fields find that they speak so little the same language that they can sometimes scarcely understand each other at all.

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[2] Karpinski, "Algebraical developments among the Egyptians and Babylonians," *Amer. Math. Mo.*, Vol. 24, 1917, pp. 257-265.

[3] Problems 85-90 in Simson's edition of Euclid's Data; in Opera Omnia ed. Heiberg and Menge, Vol. 6, Prop. 84-86, pp. 165-173.

[1] A review of the international journal, *Scientia.*

And yet there is a deep-seated conviction that all valid sciences must be parts of one whole, one Science, which subsumes all of them under its universal extent. If such a general science exists effectively, in the sense of a body of truth which is accessible to all intellectually minded people with a desire to understand it, it must be possible to gather the essentials of this science into an organized whole whose connections are not very complicated. This science must be organized along rather simple lines and its main truths must be capable of being brought into connection under a few general headings of a comprehensive character.

To accomplish this synthesizing of exact truth requires a great international work of scientific synthesis—a work in which different peoples and different sciences are brought together in a large constructive effort. It is not desirable, and it would be impossible, to bring the necessary group of people together in a definite organization and to carry out this work by means of a concentrated effort under the direction and inspiration of a central organization. This is not the way in which the task is to be accomplished. What is needed for the purpose in mind is a world's arena for the highest philosophic and scientific analysis and discussion among the greatest living thinkers, among those who are now advancing the separate sciences and at the same time are looking for those connections which bind all science into a great and fundamental unity.

A unique journal for serving these purposes now exists in *Scientia*, an international review of scientific synthesis published at Milan, Italy.[2] This journal has an interesting feature which makes all of its articles accessible to those who read the French language. If an author writes for it in a language other than French his article is published both in its original language and in a French translation. This journal serves as a great international encyclopedia of current philosophic synthesis of scientific truth. It is doing a great international work which would be left undone if it did not render this service. It is much more than a storehouse for such articles as are submitted to it. It organizes the preparation of important series of papers by the experts of all countries, the papers in a particular series all dealing with the various aspects of some important subject.

At the present time, for instance, a series of articles on relativity is being prepared by experts from all over the world; and these will be published in due course. Each writer, even on this difficult and abstruse subject, is required to express himself in the language which is current among educated men and women everywhere. He is denied the use of the technical language which the experts employ in communication with each other. That technical language has its use. But what is expressed in it is inaccessible to those who are not experts. What *Scientia* demands is the exposition of the important ideas of relativity in a language which is free from technical expressions so that the articles may be accessible to thinkers in every field of thought. A similar demand is made with respect to all the articles which are to be published in *Scientia*. The editors can hardly claim that they have succeeded in holding every contributor to the ideal which they have set; but their success has been sufficiently great to make of *Scientia* a forum for the philosophic discussion of scientific questions in such a form as to elicit the interest of all people who believe in the broad philosophic synthesis of science.

A great purpose has inspired both those who initiated the publication of *Scientia* and those who have continued its work. They have desired to place at the disposal of every cultivated person an instrument of scientific synthesis which might facilitate that work of coordination and systematization of knowledge rendered necessary by the growing need of rapid summaries and careful accounts of central ideas suitable to enable one quickly to orient himself with respect to the most vital scientific ideas of the day. In serving this purpose the editors have realized that it is necessary to give rigorously exact information concerning new researches and the hypotheses which are elaborated or proposed by various workers for extending the bounds of human knowledge; and they have spared no pains to procure accounts of these by the experts best fitted to give them—accounts which move not in technical terms but in the language of all cultivated people. The new ideas and discoveries are thus being rendered accessible to all persons, with the hope that science may live more as a unit both among scientific workers generally and also in the minds of all cultivated persons who are interested in the work of science. *Scientia* is seeking to bring the great guiding ideas of science out of the scientific preserves of individuals and of small groups and to help make it possible for all to enjoy the intellectual advantages of scientific thought and discovery. If the world of thought tends to become little to any one through an over-emphasis of his specialty, *Scientia* is effectively urging him to come out into a broader field of scientific thought. Let him still pursue his narrow specialty with all vigor and ardor, if he will; but let him at the same time see it as a small part of a fascinating whole and let him understand that the connections of his specialty with this whole are more important in their human values than the details of his work are in themselves.

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[2] *Scientia*, edited by Eugenio Rignano and published at Via A. Bertani, 14, Milan, Italy. American subscribers can conveniently purchase it through Messrs. Williams & Wilkins, Mount Royal and Guilford Avenues, Baltimore, Maryland, at ten dollars per year (twelve issues).

Through the pages of this unique journal the leading thinkers of Europe and America are contributing towards a realization of this inspiring ideal. Independence of judgment, clearness of form, absence of all prejudice, liberty of criticism characterize their contributions. The continued success of this effective organ of international culture is a matter of importance to the development and unification of science. It aims at reaching a systematic and synthetic order of truth suitable to give a general view of the physical and human world within the limits of the most rigorous scientific knowledge. In carrying out this plan it has organized cooperation in the preparation of articles on the causes of the great war, on the international questions growing out of it, on social questions, on the problem of vitalism and mechanism in biology, on the now famous theory of relativity, on the contributions of the various peoples to the development of the several branches of human knowledge, and on other questions of deep interest in the current thought of the world.

By these means *Scientia* has become suitable to serve as a valuable instrument for the cultural development of all those who love knowledge. Specialists may find in it an incentive to look beyond their own gardens of thought, to enlarge their intellectual horizons and to increase their joy in truth. People of culture have through it a unique opportunity to become acquainted with many trends of current thought and to obtain a panoramic view of the intellectual world. Perhaps there is no other single journal in the world which so effectively brings to its readers a knowledge of the present currents in the intellectual life of mankind. Now in its seventeenth year, *Scientia* seems to have received a new impulse from the novelty and importance of the problems which have been pressing upon men in the recent eventful years. It is achieving with increased success its object of reacting against the excesses of specialism and of breaking down the partitions which have separated one from another the diverse branches of science and those who cultivate them.

Such is the work for which *Scientia* stands and such is the ideal which it holds up before all scientific workers.

This ideal, as supported by *Scientia* and various other agencies throughout the world as well as by a considerable number of individual thinkers, may yet inspire a greater work than any which can be accomplished by the more or less fragmentary articles of a periodical. It will do much to furnish the material to some great thinker who will give his life to a fresh synthesis of truth and it will hold up his hands in the arduous undertaking. The materials for such a comprehensive synthesis should be gathered and put into order in such a form that an original thinker who would encompass all of them would find it possible to do so in a lifetime and still have left that energy which is necessary to fuse and unite the whole material in the fire of his intellect and mould it into a great (even though tentative) synthesis of scientific truth.

Such a work can not be done once for all. Science continues to grow and novel thoughts arise occasionally in its progress. These will ever require new syntheses if they are to be comprehended properly. No such work of philosophic interpretation can ever be final, for science itself can never reach a final and completed stage. Each generation or century will need to do it again; but this lack of finality does not make the work of any the less importance.

It is important that the great scientific ideas of each generation should come out of their technical dress and be set forth in a literary form which makes them pleasingly accessible to all cultivated persons with a tendency to philosophic interpretation. To this double work of the synthesis of truth and the putting of it into an accessible form the editors of *Scientia* have committed that journal, and it is going forward with increasing success towards the realization of this high aim.

R. D. Carmichael
University of Illinois

SPECIAL ARTICLES

PARAMAGNETISM AND THE THEORY OF QUANTA

The last issue of the *Journal de Physique* contains an interesting and meritorious review by B. Cabrera of the extensive work done by different observers on the magnetism of salts of metals of the iron group. A conspicuous part of this work is due to Professor Cabrera himself and to his pupils and was heretofore outside the reach of most of the scientific readers, because it was published in Spanish journals.

I wish to draw the attention of the physicists engaged in magnetic research to an interpretation of which the material presented by Professor Cabrera is susceptible, and which seems to me to be a strong support of the quantum theory of magnetism. It is well known that the theory of electrons gives a simple relation between the magnetic moment of an atom m and its chief moment of momentum G

$$(1) \qquad m = \frac{e}{2\mu} G$$

e/μ being the ratio of the charge of an electron to its mass. On the other hand, the theory of quanta admits only certain discreet values of the moment of momentum G, *to wit*, whole multiples of the value $h/2\pi$, where h denotes Planck's universal constant of action. The result is that the magnetic moment of an atom (or ion) is also a whole multiple of an elementary value

$$m_0 = \frac{eh}{4\pi\mu}$$

so that

$$(2) \qquad m = j\, m_0$$

where m_0 is called the "Bohr-Magneton" and the integer j (in *Sommerfeld's* terminology) the "internal quantic number" of the atom.

The conception that the atomic magnetic moment is a multiple of a "magneton" was originally introduced empirically by *P. Weiss*. However, the empirical "Weiss-Magneton"

Ion	m in W.-M.	j	m' in W.-M.	m' in M_0	$\gamma \cdot 10^4$ calc.	$\gamma \cdot 10^4$ obs.
Cr^{+++}	19.0	3	15.2	3.04	4.8	5.0
Cr^{++}	24.0	4	20.2	4.04	7.7	7.9
Mn^{++}	29.0	5	25.2	5.04	11.3	11.6
Fe^{+++}	28.9		25.1	5.02		11.5
Fe^{++}	26.0-29.0	4	22-24.4	4.4-4.9	7.7	9.3-11.6
		5	22.6-25.2	4.5-5.04	11.3	
Co^{++}	24.0	4	20.2	4.04	7.7	7.9
Ni^{++} saturated	16.0	3	12.9	2.6	4.8	3.5
Ni^{++} unsaturated	13.0	2	9.5	1.9	2.5	2.3
Cu^{++}	9.1	1	5.26	1.05	1.9	1.1
Cu^{+}	0	0	0	0	0	0

(W.-M.) has a value almost exactly five times smaller than the theoretical "Bohr-magneton." *Weiss* obtained his values for the atomic magnetic moments of ions in solutions from the measured susceptibilities χ by means of *Langevin's* formula based on classical statistics

$$(3) \qquad 4\pi\chi = \frac{Nm^2}{3kT}$$

Where N denotes the number of atoms (or ions) in unit space, k Boltzmann's constant and T the temperature. *Cabrera* uses the same method of theoretical analysis and derives values of m in Weiss-magnetons as units.

It has been, however, pointed out by *W. Pauli* (*Phys. Zeitschr.* 1920, xxi, p. 615) that the statistics of the quantum theory lead to a different result and that *Langevin's* formula must be replaced by the new one

$$(4) \qquad 4\pi\chi = \frac{(j+1)\,(2j+1)}{6j^2} \; \frac{Nm'^2}{kT}$$

We see that from the point of view of the quantum theory the values m derived by *Cabrera* need a correction, and that the new value m' will be $m' = \alpha m$, where the correction factor α has the form

$$(5) \qquad \alpha = \frac{j}{\sqrt{(j+1)\,(j+\frac{1}{2})}}$$

j:	1	2	3	4	5	6
α:	0.577	0.730	0.802	0.842	0.870	0.890

The application of these considerations to Cabrera's material is contained in a following table. The second column gives the values of m in Weiss-magnetons, which this author considers as the best mean of the results of different observers. It may be remarked that some of the authors find values lying rather far from whole numbers, so that the integral nature of this quantity does not seem quite assured to the unprejudiced observer. In order to find the corrected value m', it is necessary to make a hypothesis as to the number j of Bohr-Magnetons in the atom. This hypothetical j is given in the third column, while the fourth contains the result of the correction in Weiss-Magnetons, from which the value of m' in Bohr-Magnetons is obtained by dividing by five (fifth column). The agreement of the final result of the fifth column with the hypothetical j of the third gives a measure of the extent to which the hypothesis was justified. It will be remembered that j represents the number of Bohr-Magnetons m_0 contained in an atom, so that the third column gives our hypothesis as to this number, while the fifth contains the same number as derived from Cabrera's experimental material. We see that there exists an apparent discrepancy in Ni^{++} in saturated salts and for Fe^{++}. However, the case of Fe^{++} is without any significance, because the uncertainty of the experimental values is here so large as to prevent any conclusions. The rest of the paramagnetic salts shows an excellent agreement with the quantum theory.

There may be suggested still another and more convenient method for checking these results. By means of formula (3) we can compute the susceptibilities (referred to the grammatom of material) corresponding to the individual integer j. We have tabulated these values of the susceptibility in the sixth column, while in the seventh the actually measured values are given for comparison.

Again we see that a discrepancy larger than the limits of experimental error exists only for *Ni*. Physicists engaged in magnetic research would therefore promote the development of the theory of quanta by paying particular attention to the ions Fe^{++} and Ni^{++}.

Paul S. Epstein

Norman Bridge Laboratory of Physics,
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THE AMERICAL CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Robert E. Wilson, *chairman*

Graham Edgar, *secretary*

Section I. General Inorganic and Physical Chemistry.

Studies by a new method of analysis of complex crystal structures and normally and abnormally reflected secondary X-rays characteristic of chemical elements in crystals: George L. Clark. (1) A new ionization spectrometer method of analyzing crystals has been designed to be applicable to variable parameter systems (triclinic, monoclinic, orthorhombic), and to be independent of previous determinations of structure, number of molecules per unit, wave-length and densities. Wave-lengths producing particular effects are accurately evaluated by an experimental determination of the critical voltage in the quantum law $Ve = hc/\lambda$. (2) By this method crystals and powders of the following compounds have been studied and structures determined; KI, simple cubic, $d = 3.532$; CsI, cube-centered, $d = 4.562$; KI_3, cube-centered slightly distorted into monoclinic prism, $d_{100}{}^b = 4.70$; CsI_3, orthorhombic, $d_{100} = 4.50$, $d_{010} = 6.43$, $d_{001} = 7.02$, 3 I atoms on body diagonal; $CsIBr_2$, orthorhombic, $d_{100} = 4.26$, $d_{010} = 5.91$, $d_{001} = 6.90$, CsI and Br planes equally spaced for 100 series. (3) New phenomena of great importance have been incidentally discovered: (1) the production of secondary X-rays characteristic of elements I, Cs and Br in crystals, appearing alone in spectra when the potential is below that required for the generation of the line spectrum of the target element tungsten, obeying the law $n\lambda = 2d \sin \theta$, and enabling distinction between Cs and I in the same crystal; (2) in addition the abnormal reflection of characteristic Iodine rays from KI, varying in direction in an anomalous fashion with the angle of incidence, corresponding to no one set of planes, not obeying the usual laws and unexplainable by present theories. These things have direct bearing upon the mechanism of X-ray reflection and excitation, orientation, damping, electronic structure, mutual atomic effects.

Electron positions in crystals: MAURICE L. HUGGINS. A careful analysis of the various conceivable ways in which the valence electrons or electron orbits might be distributed in crystals such as C, Si, Ge, SiC, ZnS, AgI, AgCl, NaCl, etc., based solely on the assumptions: (1) that the arrangements of atomic centers in the crystals have been correctly determined by means of X-rays, (2) that these arrangements are due to the attractions and repulsions between nuclei and electrons, and (3) that the number of valence electrons is 1 for Na and Ag, 2 for Zn, 4 for C, Si and Ge, 6 for S, 7 for Cl, Br and I, etc., shows that the valence electrons in these compounds *must* be in relatively fixed positions *in pairs at tetrahedron corners* around the kernel of each electronegative atom. In some cases they also form a tetrahedron of pairs around the kernel of each electropositive atom. This conclusion is in accord with the observation that, assuming only (1) and (3) above, the number of valence electrons in every crystal containing electronegative atoms whose structure has been determined by X-rays, excepting only Cr, Mo, Ta, W and the trihalides, is precisely the number required for a tetrahedron of pairs around the kernel of each electronegative atom. Furthermore, this result is predictable, without any new assumptions being necessary, from the system of atomic structures previously proposed (*J. Phys. Chem.*, xxvi, 601, 1922).

The determination of crystal structures without X-rays: MAURICE L. HUGGINS. A study of the arrangements of valence electrons in crystals whose atomic arrangements have been determined by means of X-rays has made it possible to predict the structures of many crystals and in some cases to verify these predictions by means of data other than that obtained by X-rays. The crystals considered, besides a number whose structures have been determined by X-rays, include ZnTe, CdSe, CdTe, HgS, HgSe, HgTe, AuCl, BN, BP, AlN, AlP, AlAs, SiO_2 (cristobalite), TiO_2 (rutile and anatase), SnO_2 (cassiterite), MnO_2 (polianite), Mn_2O_3, Mn_3O_4 and Al_4C_3. In each case the assumption that the electrons are in pairs at tetrahedron corners around each atomic kernel (compare preceding abstract), and the available crystallographic data are sufficient to limit the number of possible structures to 1 or 2. These structures are checked up chiefly by comparisons of interatomic distances.

Further interesting tracks of alpha particles in gases (lantern): R. W. RYAN AND W. D. HARKINS.

A new relation concerning the periodic system of the isotopes (lantern): W. D. HARKINS.

On the disintegration of atoms: W. D. HARKINS.

The separation of mercury into isotopes in a steel apparatus (lantern): W. D. HARKINS AND S. L. MADORSKY.

The relation between thermoelectric force and the rate of evaporation of electrons from hot filaments: WORTH H. RODEBUSH. The equation derived by the author (*Journal A. C. S.*, March, 1923) for rate of evaporation gives values for the rate of evaporation of electrons from tungsten molybdenum and titanium filaments at 2000° K. which agree closely with Langmuir's data. Dushman has derived an equation which probably gives even closer agreement with the experimental values, but which does not appear to allow for the existence of thermoelectric force. From the author's equation, with the aid of thermodynamics, a relation is derived between thermoelectric force and the rate of evaporation of electrons, and it appears possible to calculate the latter by measurement of the former at high temperatures. The assignment of specific heat to the conducting electrons in a metal appears to be an assumption not required by thermodynamics and contradicted by experimental evidence.

Absolute potential measurements: H. P. CADY AND GEORGE LYNN. The work was done by using a quadrant electrometer, one pair of quadrants being composed of mercury and the other the solution under investigation. The following is a summary of the results:

Trial No.	Method	Potential of Hg				
		Calomel			Hg_2SO_4	
		Sat.	N/10 KCl	N KCl	N KCl	N/10 KCl
1	Zero		—.157	—.283		
2	Deflec.		—.080			
3	Zero			—.170		
4	Deflec. (siphon)			—.212		
5	Deflec.	+.150				
6	Deflec.	+.175				
7	Deflec.	+.215	+.040	—.025		
8	Deflec.				+.050	+.097
9	Deflec.				—.200	—.160
10	Deflec.				—.085	—.047

None of the results approaches the value +.56 volts for the normal calomel electrode, but rather, with one exception, indicate that the mercury is negative to the solution and the values found for the N/10 calomel electrode agree fairly well with those published by Garrison.

A critical discussion of some generally accepted assumptions regarding cells with a liquid junction: GEORGE SCATCHARD. The proof of the elimination of liquid junction potentials by a saturated potassium chloride bridge, even the experimental proof, depends upon the assumption that the activities of the two ions of hydrochloric acid are equal. This assumption leads to considerable liquid junction potentials when the solvent is varied by increasing quantities of sucrose. The generally accepted formula for the electromotive force of a concentration cell with transport involves the assumption that the transport numbers are independent of the gradient of the ionic concentration. With sugar solutions this formula appears to give very erroneous results.

A comparison of electromotive force and freezing-point data: STUART J. BATES. By means of the following equation, the difference (ΔE) between the electromotive forces of cells, such as H_2, HCl (c), AgCl plus Ag, containing the electrolyte at different concentrations, may be calculated from the freezing-points of the solutions involved:

$$\frac{NF\lambda}{RT} \Delta E = \frac{(\theta 1}{(C_1} - \frac{\theta 2)}{C_2)} \int_{C_2}^{C_1} \frac{\theta}{C} \, d \ln C.$$

For HCl observed values of ΔE for the concentrations 0.005 and 0.05 M are Noyes and Ellis 0.11248 volt, Linhart 0.1126. That calculated from the freezing-point data employing the "best values" of Noyes and Falk is 0.1146. For KCl for the same concentrations, MacInnes and Parker found 0.11085, the values caluculated from different series of freezing-point measurements are Jahn 0.11190, Flugel 0.11178 and Adams 0.11207. If, on the other hand, the above equation be employed to calculated freezing-point lowerings from E. M. F. data, the difference between the observed and calculated values is again many times that which the precision of the measurements would indicate. The following equation was found to express the relation between activity coefficients (α) calculated from freezing-point data and the equivalent conductance ratio (Λ/λ_o) : $(1 - \alpha) = K (1 - \Lambda/\lambda_o)$. By no means of this relation absolute values of activity coefficients may be calculated: these differ as a rule from those obtained by other methods. The above simple relation indicates that the factor or factors which operate in solution to decrease the equivalent conductance cause a proportional decrease in the activity coefficient.

The potential of the chlorine electrode in the presence of light: GRAHAM EDGAR AND J. A. MORROW. The potential of the chlorine electrode in hydrochloric acid solution has been measured in the dark and under intense illumination by the light of a quartz mercury arc. The light has no effect upon the potential within the limits of error of measurement (about 0.02 m.). This is interpreted to mean that light of the wave lengths employed can have no effect on the *equilibrium* between chlorine, hydrogen and hydrochloric acid gases. This is contrary to many views in the literature.

Luminescence among organo-magnesium halides: S. CALVERT, R. T. DUFFORD AND D. NIGHTINGALE. A study of over seventy Grignard compounds, of which over thirty were luminescent, reveals (1) that magnesium is necessary; (2) that ether is not; (3) that most aliphatics are inactive, while most aromatics are; (4) that substituents in the benzene ring affect the light (*a*) by their position, (*b*) by their chemical nature, (*c*) and not by their weight; (5) several very bright reactions are found, one, p. chlor. brom. magnesium benzene (MgC_6H_4ClBe), being probably the brightest on record. To give luminescence the Grignard must be derived from compounds containing halogen directly attached to unsaturated carbon.

The mechanism of the hydrogen-chloride combination: A. L. MARSHALL AND HUGH S. TAYLOR. An alternative method of testing Nernst's theory that the hydrogen-chlorine combination consists in the following sequence of reactions: Cl_2 + light = Cl Cl : Cl + H_2 = HCl + H; H + Cl_2 = HCl + Cl consists in allowing a hydrogen chlorine mixture to flow into a vessel containing free hydrogen atoms. The experimental methods of securing this and the attempts to do this will be outlined.

Hydrogen, hydroxide and halide ions as inhibitors of photochemical reaction: W. T. ANDERSON, JR., AND H. S. TAYLOR. The inhibition of the photochemical decomposition of hydrogen peroxide by hydroxide and halide ions has been shown by a study of the velocity of decomposition of peroxide solutions containing these ions in amounts varied by addition of neutral salts.

The method of Willard Gibbs in chemical thermodynamics: W. LASH MILLER. In his treatment of the problems of chemical thermodynamics, Willard Gibbs postulated the two laws, invented what functions he needed to put them into form convenient for handling the problems presented by the laboratory, and developed equations for their solution which themselves suggest what experimental data must be supplied. The methods employed in current text-books of physical chemistry differ radically from that of Gibbs and are applicable only to artificially simplified problems; the reason usually advanced is the lack of suitable mathematical preparation on the part of students of chemistry. The customary elementary course on the calculus deals almost exclusively with explicit junctions of a single variable, while the physical chemist deals with functions of at least four independent variables, seldom presented in explicit form. Suggestions for modifying the customary course were made, which without adding to its length or its difficulty or detracting from its educative value, would make it applicable to the needs of chemists.

Interpretation of osmotic phenomena in terms of a modified form of the phase rule: A. S. McDANIEL.

The ammonia equilibrium: A. T. LARSON AND R. L. DODGE. The ammonia in equilibrium with $N_2 + 3H_2$ at pressures of 1, 10, 30, 50 and 100 atmospheres has been determined for the temperature range 300°—500°C. The experimental results obtained are in fair agreement with Haber's calculated values. It is shown that the equilibrium constant is not independent of the pressure, as has been assumed by earlier investigators, the differences increasing as the temperature is lowered.

The interpretation of time-temperature curves: DONALD H. ANDREWS. A form of apparatus has been constructed such that the substance under observation loses heat at a rate proportional to the temperature difference between the substance and its surroundings. Under these circumstances the temperature of the substance can be expressed as a function of time, temperature head, the heat capacity and heat of fusion of the substance and the characteristics of the apparatus. In this way one can secure greater accuracy in the interpretation of the cooling curves of a binary or ternary mixture as compared with methods of interpretation which have been in general use.

Simplified construction of ternary freezing-point diagrams: G. T. KOHMAN. Several investigators have observed that certain binary and ternary systems, composed of ortho-meta-para isomers, behave substantially as ideal solutions. In the course of investigations of the thermal relation in such systems, it was noticed that this holds for all the cases which have been considered hitherto. This observation has resulted in the development of methods which enable one to construct the solubility diagram of this type of system from a small number of experimental determinations. These methods make it possible also to estimate very closely binary and ternary eutectic temperatures and compositions. Consequently they are of interest in view of the importance of solubility diagrams as a means of analyzing mixtures of ortho-meta-para isomers.

The system—silver perchlorate, aniline and water: ARTHUR E. HILL AND RUDOLPH V. MACY. The system has been studied from the eutectic (—57°) to plus 48°. The binary system silver perchlorate and aniline shows 4 compounds, respectively with 6, 3, 2 and 1 mol. of aniline to 1 of $AgClO_4$. The compound $AgClO_4$. 6 An. is soluble in aniline to 5 per cent. at 25°, and melts congruently at 60.5°. The transition point to the 3-aniline compound is 48.3°; the later changes to the 2-aniline compound at 66.6°. The transition to the 1-aniline compound is above 100°, at which temperature oxidation of the aniline to nitrobenzene interferes. In the ternary system, the distribution of $AgClO_4$ between water and aniline is *wholly* in the aniline phase up to the point of saturation (9 per cent. $AgClO_4$). Both the 6-aniline and the 3-aniline compound are extremely insoluble in water; with excess aniline present, silver can not be detected in the water layer by addition of HCl, and with excess $AgClO_4$ present aniline can not be detected by Runge's test. Nine quintuple points have been found between —57 and plus 48°.

CHARLES L. PARSONS,
Secretary

SCIENCE

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DYSTROPHIC MORPHOLOGY AND ITS SIGNIFICANCE[1]

AMONG the environmental factors which influence the structure and functions of the living organism, nutrition is of primary importance. One of the most fruitful methods of studying the process of nutrition is that of inanition. By withholding or decreasing the normal diet (total inanition) or merely one or more of the essential nutritional elements (partial inanition), we may observe effects which throw much light upon the normal process of nutrition from the standpoint of physiology, of pathology or of normal morphology. It is with the morphological aspect of the problem that we, as anatomists, are primarily concerned. We desire to learn the significance of the form and structure of the living organism and the factors concerned in its morphogenesis.

Experimental work by many investigators in this field during the past century has resulted in a large number of widely scattered data concerning the effects of inanition upon the growth and structure in numerous species. These effects of inanition have been extensively and carefully studied, not only in the vertebrates, but also among the lower organisms, the invertebrates and the plants. It may therefore be profitable to review briefly some of the principal results of inanition in these lower forms, partly because they are less well known to anatomists in general and partly because certain aspects of the problem are more clearly revealed in these simpler organisms. In general, only those phases will be considered which appear of most significance in comparison with the results in the higher animals, including man.

EFFECTS OF INANITION IN PLANTS

Plants in general, much more than animals, appear susceptible to modification by various external factors, including the food supply. It is difficult to summarize briefly the principal morphological effects of inanition upon plants on account of the wide range in the character of these organisms and the great differences in their mode of nutrition. In general, however, it is clear that the effect of inanition is to restrict or inhibit their growth during the developmental period, often resulting in premature development with the production of marked abnormalities of form and structure. In the poppy (*Papaver*) an inheritance of some of the experimentally produced variations is claimed (De Vries, Hoffman, Rignano). In later stages the plants are usually less susceptible; but sooner or later a deprivation of nutriment will usually produce protoplasmic atrophy and progressively degenerative changes in the cells and tissues, finally resulting in the death of the organism. Of the cell constituents, the formed storage products (starch, oil, etc.) are usually consumed first; then the cytoplasmic structures are attacked; lastly the nucleus, which is the most resistant.

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[1] Presidential address, American Association of Anatomists, Chicago, March 29, 1923.

These effects are produced not only by general or total inanition (either complete or incomplete) but also often in a strikingly characteristic manner by partial inanition, when there is a marked deficiency of only one (or a few) of the numerous essential factors of plant nutriment. Lack of any one of these factors—water, calcium, potassium, magnesium, iron, phosphorus, sulphur, manganese, nitrogen, carbohydrates and possibly vitamins—will cause stunting of growth with variable degenerative cell-changes. These are expressed by morphological and physiological derangements, often resulting ultimately in the death of the organism. The effects are apparently most severe in the case of phosphorus or nitrogen deficiency.

In addition to the deleterious effects more or less common to all these partial deficiencies, there are in each case certain peculiarities due to the special functions which each of the food-elements normally performs. These peculiarities appear also to vary considerably in different classes of plants.

Thus water deficiency is usually expressed promptly by characteristic changes in form and structure of plants on account of its fundamental importance in morphogenesis and vital structure, as well as in transportation. Of the various salts, those of calcium, potassium and magnesium are especially essential for chlorophyll production and starch formation. Phosphorus appears to be more concerned with the transformation than with the origin of carbohydrates. Cellulose formation proceeds in the absence of phosphorus, but is impossible without calcium. Mitosis may occur in the absence of calcium or of magnesium, but not without potassium or phosphorus. The process of inflorescence and the development of the sexual organs in general appear to be unusually susceptible to the effects of malnutrition and in some cases (especially in fern prothallia) a deficiency of calcium or nitrogen may influence sex by inhibiting the development of the female organs (archegonia).

EFFECTS OF INANITION IN PROTOZOA

Some of the more important results of inanition among the protozoa may be indicated briefly in relation to changes in body size, endoplasm and ectoplasm, nucleus (macronucleus and micronucleus), reproduction (cell-division and conjugation) and recovery upon refeeding.

Change in size and form of the body—All the evidence shows a marked reduction in the size of protozoa during inanition. The maintenance of the original size in *Noctiluca* is merely apparent, the increase in peripheral vacuoles masking the decrease in cytoplasm. The recorded data indicate a decrease in length to about one half of the original in *Paramecium*, one fifth in *Stentor* and one tenth in *Dileptus* and *Pleurotrichia*. Thus in these extreme cases the volume may be reduced to less than one per cent. of the original. The rapidity of the loss varies according to temperature. There are also more or less marked and variable changes in form accompanying the diminution in the size of the body.

Changes in the endoplasm—The cytoplasmic changes at first appear chiefly in the endoplasm, which becomes progressively reduced in amount and transparent, on account of the disappearance of the food-vacuoles and similar inclusions. In the later stages of inanition a progressive vacuolation of the endoplasm has been described in various species by all recent observers except Lipska. Such vacuolation of the endoplasm apparently does not occur in *Noctiluca* and *Pleurotrichia,* however, and Lipska's results indicate that even in *Paramecium* it is probably only an indirect effect of inanition, being due primarily to other environmental factors.

Changes in the ectoplasm—In all cases the cell-membrane and associated ectoplasmic structures (cilia, trichocysts, cytopharynx, etc.) appear more resistant than the endoplasm, but in the later stages of inanition they also may be attacked and partially resorbed. Associated with these regressive changes there is a progressive decrease in motility and in other vital phenomena.

Nuclear changes—The nucleus in general is much more resistant than the cytoplasm, but may show changes in form with loss of chromatin content. In forms such as *Paramecium,* with macronucleus and micronucleus, the former shows more distinct changes. In the earlier stages of inanition it frequently elongates and enlarges. Later it usually divides and may show degenerative changes, with granulation, vacuolation, fragmentation and variable extent of resorption. The micronucleus usually persists practically unchanged, although rarely it may divide with reunion of the daughter nuclei. This persistence of the nucleus is a factor of great importance for the survival of the organism during periods of inanition. The less important constituents of the organism are usually consumed first, the most essential apparently survive longest. The persistence of the nucleus during starvation recalls a similar behavior when living cells are engulfed and digested (*e.g.* by *Trichosphaerium,* according to Schaudinn) and in trypsin digestion experiments upon dead cells. This may be of significance as indicating the presence of similar enzymes during the autolysis of cells in starvation.

Effects on reproduction—The relations of inanition to reproduction in protozoa have attracted much attention. Many observers have noted an apparent stimulus to division resulting from a brief period of starvation. R. Hertwig, however, observed that while under certain conditions fasting protozoa may divide more readily than well nourished, as claimed by Jickili and others, this does not occur as a general rule. In *Paramecium,* which has been more extensively studied, divisions occur to a variable degree in the early stages of inanition, but rarely or never in the later stages. According to Hertwig's theory, inanition upsets the cell-equilibrium as expressed by the nucleus-plasma ratio; but the relative increase in the nucleus may be equalized later by a reduction in chromatin, associated with the process of conjugation.

Rolph, who proposed a nutritive theory of sex, claimed that conjugation occurs in protozoa when conditions result in an interference with their nutrition. Thus sex is considered as primitively a form of hunger, which drives the organism to engulf its neighbor ("isophagy"). A similar theory of sex was elaborated by Geddes and Thompson. The studies of Maupas and of numerous more recent investigators, however, have shown that the life cycle of the protozoa, with its phases of sexual and asexual reproduction, is apparently a very complicated process, involving both internal and external factors. Among the latter, inanition is doubtless an important factor, which under certain conditions may induce conjugation. This was observed by Maupas and others in numerous species of Infusoria. Hertwig discovered that when low temperature cultures (which have a relatively large nucleus) are placed at a high temperature and kept without food, an artificial depression is produced which leads to conjugation. This was confirmed by Prandtl for *Didinium,* and by Popoff for *Epistylis.* Conjugation has been observed in the earlier stages of ordinary inanition in *Paramecium* by Kasanzeff, Wallengren and Chainsky; but Calkins and Lipska found inanition very unfavorable to conjugation. It is evident that further research is necessary in order to clear up this fundamental problem.

Recovery upon refeeding—The protozoa show an astonishing capacity for recuperation upon careful refeeding after inanition. Maupas found that an atrophic *Stentor* regained its original size in two days of abundant realimentation, which evidently involved an increase of over one hundred times its reduced volume. Joukowsky observed a similar remarkable capacity for recuperation in *Pleurotrichia.* In *Paramecium* Wallengren found a normal recovery possible, even in the greatly vacuolated condition after fifteen days of inanition. Lipska, however, found recovery in general possible only up to four or five days of inanition. The process of recovery is the inverse of that during inanition, and cell-divisions begin after three to five days of refeeding. Jennings noted that variability in size is increased during refeeding, some individuals recuperating more rapidly than others; but the normal condition is eventually restored.

EFFECTS OF INANITION AMONG THE HIGHER INVERTEBRATES

Although it is impossible to summarize satisfactorily the effects of inanition upon such a large and varied group of organisms as those represented by the metazoan invertebrates, it may be profitable to review briefly some of the principal features involved.

Effects on body weight and size—As pointed out by Pütter, the possible decrease in dimensions during inanition is much less in those forms having a firm skeleton (*e.g.*, Arthropoda). The maximum possible reduction in body weight and size varies greatly among the higher invertebrates, ranging from fifteen or twenty per cent. in some Arthropoda to over ninety per cent. in some coelenterates and planarians. Among coelenterates, *Hydra* is reduced to one seventh or less in length; the jellyfish *Aurelia* to one fourth and *Cassiopea* to one twenty-fifth of the original volume. Planarians (flatworms) may be reduced one twelfth in length and to one three hundredth in volume. In the snail *Helix*, the loss in weight apparently varies from eleven to fifty per cent. or more, according to species and conditions, with much individual variation. Among the Arthropods a loss of seventy-five per cent. in weight is recorded for the water-flea *Daphnia* and of fifteen per cent. for the crayfish *Astacus*. Great variation has also been found among the insects.

There are relatively few data on the loss during inanition in larval stages. The larvae of the sea-urchin *Strongylocentrotus lividus* may decrease to half the diameter of the original ovum. *Chortophaga* nymphs lose twenty to twenty-five per cent. and the tent-caterpillar (*Clisiacampa*) thirty-five per cent. The remarkable reduction (to one six hundredth) in the larva of the beetle *Trogoderma* is apparently exceptional. The loss during the pupal stage in general appears relatively slight.

Effects on the form of the body—During inanition the body is not only reduced in size, but also frequently more or less changed in form. *Hydra*, for example, becomes at first abnormally elongated, later greatly contracted and relatively broader. The water-flea *Daphnia* presents a peculiar modification of body form attributed to malnutrition and said to be hereditary (Woltereck). In the sponges, the coelenterates and the planarians the changes are remarkably great, not only in external form but also in corresponding internal structure. The so-called "reduction" process in these forms more or less resembles a reversal of the developmental process, which will be discussed later. In planarians the involution frequently involves the posterior portion of the body to a greater extent, resulting in a relative enlargement of the head region. This is also true of the nemertine worm *Lineus lacteus*, but not of *Lineus ruber*, which illustrates the differences which may occur between species.

Changes in various organs and tissues—It is a remarkable fact that the various organs and tissues of the invertebrate body differ greatly in their resistance to inanition. Some undergo changes very quickly, others only after longer periods, and still others show a remarkable resistance. There are also differences in the extent of atrophy, as well as the order of sequence.

In the medusa *Cassiopea* the loss is almost entirely at the expense of the gelatinous ground substance; while in sponges, on the contrary, this substance is increased in amount. The ectodermal structures are more resistant but they atrophy to a variable extent in different regions. In planarians the intestinal epithelium, eyes, pigment tissue and sexual duct systems are affected relatively early; the muscles atrophy later, while the gonads and nervous system persist with great tenacity. In *Lineus* the relative resistance of the various tissues is somewhat similar to that in planarians. Although among the higher invertebrates the skeleton is usually unaffected by starvation, in the snail *Helix* the calcareous shell is attacked as well as the soft tissues; while in sponges the results appear variable. Calcium deficiency usually causes involution of the invertebrate calcareous skeleton, both in larval and adult stages. In the reproductive passages of *Helix* the non-glandular parts appear more resistant than the accessory albuminous gland, which undergoes an enormous involution. While the gland cells are greatly reduced, however, the associated "parenchyma" (stroma) nuclei persist and proliferate by amitosis.

Effects on the gonads and sex—The effects of inanition upon the reproductive system and process have aroused much interest and have been carefully observed in various invertebrates as well as in other organisms. In forms where the process of reproduction may be either asexual (by budding, fission or parthenogenesis) or sexual, the tendency of abundant nutrition is to favor asexual reproduction; while inanition or other unfavorable environment usually occasions a change to the sexual form, in many cases especially favoring the development of males. The gonads themselves are usually very resistant to starvation, being (like the nervous system) as a rule among the last of the organs to undergo involution. There are, however, evident variations in different species and individuals.

Among sponges the process of involution during inanition frequently results in the formation of numerous small bodies ('gemmules'), from which new individuals may be reproduced later. In *Hydra* budding is inhibited but the gonads, especially the testes, may mature in spite of the atrophy of the body as a whole. The predominating development of testes in *Hydra* during inanition was emphasized by Nussbaum, Schultz and Berninger, but was denied by Hertwig, Whitney, Hänel, Krapfenbauer and Frischholz.

In planarians asexual reproduction is inhibited by inanition and there is a return to sexual reproduction; but the 'cocoons' are reduced in size and the number of enclosed young markedly diminished. In the nemertine worm *Lineus* the gonads undergo partial involution, but some areas (likewise the ducts) are very persistent.

In the rotifers (wheel-animalcules) Leydig noted that inanition causes prompt atrophy of the ovary and a tendency to production of males. Nussbaum concluded that in the rotifer *Hydatina* underfeeding in the *phase preceding the ripening of the ovum* tends to produce male offspring. This was confirmed by Lennsen but opposed by Whitney. Shull concluded that sex in *Hydatina* is determined by both internal and external factors, but that the production of males during inanition is probably only an indirect effect.

The relation of nutrition to sex has also been studied extensively in the crustacean water-fleas by Leydig and others. The change from parthenogenetic to sexual mode of reproduction under unfavorable conditions (especially inanition) in this group was noted by Kerhervé, Cuenot and Issakowitsch. More recently, the internal factors have been emphasized, although it is admitted that the hereditary tendency may be influenced by external factors, such as malnutrition, especially during the labile period of the ovum. Green recently concluded that in *Simocephalus* the sex is probably predetermined in the ovary, but is also subject to environmental influence, though probably not through starvation.

Among the insects the relations of nutrition to sex have been noted especially in the aphids (plant-lice), the Lepidoptera and the Hymenoptera. The appearance of winged male forms in aphids as a result of underfeeding was noted by Kyber (1813), Leydig and others. The same phenomenon in the grape-louse *Phylloxera* was found by Keller and Behr. Thus apparently all observers admit the effect of unfavorable environment, especially underfeeding, in causing the cessation of parthenogenesis and the appearance of males and sexual reproduction among the aphids. The conditions in this group therefore form strong evidence supporting the theory of nutritional sex-determination.

In the Lepidoptera, Treat observed a preponderance of males as a result of underfeeding the larvae of certain butterflies. This was not confirmed by Poulton, although he admitted that a lesser resistance to inanition in the female larvae might result in a selective mortality with survival of a relatively larger number of males. This, of course, is not strictly a process of sex-determination, but rather of sex-survival. In the underfeeding experiments by Kellogg and Bell on the silkworm *Bombyx* and by Guyénot and Loeb and Northrup on the fruit-fly *Drosophila,* no effect on the sex-ratio was observed.

Among the termites and Hymenoptera the sex is known to be determined by fertilization, the unfertilized eggs producing the males. The diet, however, determines the development of the female reproductive tract, which in the few larvæ well-fed (with "royal diet") becomes functionally developed, producing the "queens"; while in the less richly nourished larvæ the reproductive tract remains rudimentary, producing the "workers" of which there may be different kinds, depending upon the amount of food available. There is some evidence, however, indicating that in wasps (and possibly other Hymenoptera) the sex-ratio may be affected by nutrition, but this is somewhat uncertain.

Among the invertebrates in general we may therefore conclude from the available evidence that malnutrition tends to favor the sexual, rather than the asexual, mode of reproduction. Furthermore, especially in Hydra, rotifers, daphnids and aphids the sex-ratio is at least to some extent subject to environmental influence, inanition tending to produce a preponderance of males. Wilson concluded that nutrition is one factor which may determine sex. Schultze reached this conclusion for Hydra and Hydatina, but felt less certain regarding the daphnids and aphids. How this influence becomes effective, however, is still a matter of uncertainty. The whole question requires further investigation, especially in the light of the recent theory of sex-determination by the accessory chromosome.

Effects on cell structure—We have noted that the effect of inanition is to produce a variable decrease in the size of the body as a whole, which is found to involve a variable reduction in the various parts, organs and tissues. This, of course, depends ultimately upon the changes in the underlying units, the component cells of the organism. Some cells are destroyed and absorbed, others persist more or less changed. From his study of the histological changes in *Hydra* and planarians during the involution process of inanition, Schultz inclined to attribute the marked decrease in size of the body to a decrease in the number of cells, those persisting being practically unchanged in size. The preponderance of evidence is against this view, however. Especially in the adult organism, all the cells of the body during inanition tend to undergo more or less atrophy. The extent and character of this atrophy vary in the different tissues and in different cells of the same tissue. The decrease in the size of the body is therefore due partly to the complete disappearance of cells and partly to an atrophy of those persisting.

During the process of atrophy the cytoplasm of the starving cells undergoes in general a series of characteristic changes, first losing its stored food material, pigment, mitochondria and various inclusions. Later the cytoplasm of the cells often fuses into a syncytium. Vacuolation usually appears, with progressive decrease in amount of the cytoplasm, and terminal disintegration with complete absorption in the case of some of the cells. There is usually an earlier stage of reduction in size (simple atrophy) and a later stage of degeneration.

The nucleus is usually more resistant than the cytoplasm, giving a higher nucleus-plasma ratio. At first the nucleus may even enlarge, but later it tends to shrink (pycnosis) with perhaps ultimate fragmentation, karyolysis and final absorption. The reduction in cytoplasm and relative increase in nuclear size frequently gives the atrophic tissue an embryonal appearance.

Some further special features in the atrophic cell changes may be reviewed briefly. As noted by Terroine from the chemical viewpoint the fat changes show great variation among species and individuals. While fat in general is quickly absorbed during inanition, in the vitelline gland cells of planarians it is tenaciously retained, disappearing only when the cells undergo final necrosis. In planarians and molluscs the nerve cells may show certain degenerative changes, although the nervous tissue as a whole is remarkably resistant. It may be noted that apparently the final absorption of the degenerated cells in the various tissues is usually accomplished by simple solution in the interstitial tissue fluids; although phagocytosis has been noted in sponges, sea-urchin larvae and especially in the case of the nemertine worm *Lineus*. The process of phagocytosis is said to occur also in the metamorphosis of insects.

Some specific changes in cell-structure are noted during various forms of partial inanition. Thus calcium deficiency may loosen the intercellular attachments but it does not affect the ciliary mechanism and apparently permits mitosis to continue in the embryonic tissues of various invertebrates. Phosphorus and potassium, however, are evidently necessary for mitosis, as in plants. In addition to the mineral salts, certain proteins, fats or carbohydrates, water, etc., are doubtless essential to life, but we have as yet little data upon the morphological effects of their deficiencies among the higher invertebrates.

Effects on the developing organism—The effects of inanition upon the developing invertebrate organism, especially during the earlier embryonal stages in many respects often differ markedly from those previously described for the adult. The embryonal cells have a characteristic tendency to growth and differentiation which may enable certain organs and tissues not only to persist but even to enlarge and develop at the expense of the remainder of the starving organism. This is true for general inanition and is also especially evident during various forms of partial inanition. Thus in many cases it is evident that a deficiency in one limiting factor does not necessarily altogether inhibit the development of the invertebrate organism when that factor is exhausted, but occasions instead a disproportionate, abnormal growth, the extent and character of which will vary according to circumstances.

On the other hand, in many cases the developing embryo or larva (in some species even the adult organism) tends to undergo during inanition a series of retrogressive changes more or less reversing the normal order of development. This process (technically called 'reduction') was apparently first described by Lillie (1900) in *Planaria maculata*. It is often well marked in sponges, coelenterates and planarians, though apparently rare in the more highly organized invertebrates. Even in the lower invertebrates, however, there is some question as to whether the (often remarkable) resemblance of the atrophic organism to the earlier embryonic stages may not be more apparent than real. But in many cases these atrophic remnants are actually able, under proper conditions of nutrition, to regenerate the normal structure of the organism. Child concludes that starvation results in morphological rejuvenation, followed by physiological regeneration upon refeeding.

The relatively great resistance to inanition usually offered by the gonads has already been mentioned for adults. This applies also in some cases to the developing organism, so that sexual maturity may occur in undersized bodies as a result of underfeeding (*e.g.*, silkworm and certain bees). But in others (starfish) sexual maturity is reached only upon the attainment of a certain body size, or the development of the gonads may even be entirely inhibited by inanition (fruitfly).

The sex of the offspring, as already mentioned, may also be influenced through the effect of inanition upon the germ cells in the larval stages, particularly at certain critical periods (rotifers, daphnids, aphids, etc.). In some insects sexual maturity appears to be determined entirely by larval nutrition, in others chiefly by the adult nutrition.

Underfeeding during the larval period may also result in undersized adults (various insects) and also sometimes in marked structural modifications (pigmentation, etc.). In some cases these acquired characters appear hereditary, at least for a few generations (as found by Woltereck, Pictet, Kellogg and Bell); although ultimately upon adequate diet there is an evident tendency to return to the original condition.

The experiments with media or diets variously deficient have shown that compounds of P, K, Na, Ca, Mg, Fe, S and Cl appear necessary for development, growth being inhibited or variously perverted when the amount stored in the ovum is exhausted, unless a supply from without is available. Remarkable results in this field have been obtained by Herbst, Loeb and others. The marvelous effect of fat upon the development of the reproductive tract in the female Hymenoptera also illustrates the morphogenetic potency of a single dietary factor. As to other forms of partial inanition, Baumberger holds that protein is in general the limiting factor in the growth of insects. The fruitfly *Drosophila* apparently requires yeast as well as sugar for growth and other insects living on fermenting substrata of low protein content usually feed on the microorganisms present. Little or nothing is known concerning the possible requirement of vitamins by the invertebrates in general.

Regeneration during inanition—In many of the invertebrates indications of regenerative activity may be observed in certain cells or regions during the degenerative process of involution. Driesch noted that the reserve materials of the body which are consumed during starvation may be used to build up other parts of the organism. Thus in daphnids, crustacea and insects repeated ecdysis (moulting) with regeneration of a new exoskeleton and appendages may occur during total inanition. This regenerative process occurs notably in the lower invertebrates such as the sponges and coelenterates and has been studied especially in planarians by Morgan, Schultz and others. Here the starving organism exhibits the remarkable capacity to regenerate large portions of the body, such as the head, with all its parts, pharynx, nerve ganglia, musculature and excretory system. Thus even during starvation regeneration may restore a complete normal individual of much smaller size. In this process there is an extensive involution of the older tissues to furnish material for the regenerated parts.

Recovery upon refeeding—In general it is possible for the starving invertebrates to recover their normal size and structure upon appropriate refeeding if the process of involution has not proceeded too far in degeneration. This applies also to partial inanition. In sponges, for example, the skeleton is reformed upon restoring calcium carbonate to the medium. In planarians regeneration of the gonads is possible even when they have nearly disappeared after three or four months of inanition. In the gland cells of the snail *Helix* starved five months, evidences of recuperation were found by Krahelska even after only two days of refeeding. *Drosophila* (fruitfly) larvae are capable of normal development even after long periods of retardation on inadequate diet; and in this form, as likewise in the larvae of the beetles *Trogoderma* and *Tribolim*, the normal period of life may be greatly extended by retarding the developmental process through alternate periods of fasting and refeeding. Underfed larvae of the moths *Acronyeta* and *Bombyx* produce smaller pupae and adults, the effect in the case of *Bombyx* being carried over to the second and third generations.

COMPARISON WITH VERTEBRATES

Comparison of the results of inanition among plants and invertebrates with those found in vertebrates reveals many differences. Especially in the degree of change the vertebrates appear in general less plastic and more resistant to inanition, as to environmental influences in general. Thus while many invertebrates may survive a loss of ninety per cent. or more in weight, vertebrates usually perish when the loss reaches forty per cent. Likewise there are found among vertebrates no such radical and profound changes of structure as may occur during inanition among plants and many invertebrates, especially in those which undergo the remarkable process of "reduction."

On the other hand, amidst the diversity of phenomena resulting from inanition in the various plants and invertebrates we find certain features in essential agreement with those occurring among vertebrates, indicating a fundamental resemblance in the reactions of all living organisms. This applies not only to the general atrophy of the whole body, but also to the variable extent and character of change in different parts and organs. Thus the nervous system and (usually) the skeleton are relatively resistant to inanition in both vertebrates and invertebrates. The variable losses in the different parts of the body lead to marked abnormalities of form which differ greatly according to circumstances.

During the development in both animals and plants, inanition (especially of the chronic type) frequently results not merely in a retardation or cessation of growth, but in an abnormal, disproportionate growth, which differs greatly according to the species, stage of development, type of inanition and other factors. Some parts may show persistent growth at the expense of others, even during total inanition with continued loss in body weight. This applies likewise to various types of partial inanition. The abnormal growth occurring in the absence of certain dietary elements necessary for normal nutrition is contrary to Liebig's "law of the minimum or limiting factor" according to which (as narrowly interpreted by some authors) growth should cease when any factor essential for normal growth is exhausted. Whatever may be the influence correlating the relative growth of the various organs and parts this correlation may be markedly changed during total or partial inanition and the process of morphogenesis is accordingly subject to experimental control.

The possibility of regeneration and recuperation upon refeeding after inanition, although more strikingly evident in the lower forms, is characteristic of all living organisms. Although the effects of inanition vary widely in different cases, up to a certain stage of severity perfect recovery is possible; beyond this only partial recovery (or none at all) is possible, resulting in permanently dwarfed and stunted forms. The age at the time of inanition is very important, there being critical periods at which the various organs are most susceptible to change through inanition and other environmental factors. This is strikingly illustrated in the case of the effects upon the sex glands and possibly sex determination.

These various changes observed in the dystrophic organism are associated with changes in the constituent cells. The relative loss in cytoplasm and the resistance of the nucleus during inanition are characteristic in all plants and animals. The general result is to reduce the cell to a more embryonal type of structure with a modified nucleus-plasma ratio, which may perhaps in part explain many of the curious resultant changes in form during dystrophic growth. While mitosis is usually inhibited during inanition, it may persist with great tenacity in those organs in which growth continues.

While the cells during inanition are reduced to an embryonal condition, from which recovery is possible upon refeeding, they do not so remain permanently. Sooner or later, in all living organisms, they pass from a stage of simple atrophy to a condition of degeneration. The cytoplasm typically undergoes cloudy swelling, with subsequent fatty or vacuolar degeneration. The nucleus, though relatively more resistant, also later undergoes progressive degeneration, usually with pycnosis and finally karyorrhexis or karyolysis. It is apparent that the above mentioned possibilities of recovery depend chiefly upon the degree of cell injury which has been sustained. Cells which have undergone extensive cytoplasmic and especially nuclear degeneration are obviously unable to recuperate. There are always great individual differences, however, even among cells of the same organ, so that some may remain capable of regeneration even though others have degenerated beyond the stage of possible recovery.

The question as to why certain cells or organs have a greater resistance to inanition has received various answers. Roux has long held that during inanition those cells persist which require less food in the struggle for existence. This theory was opposed by Schultz and others who claimed that the order of disappearance of the (invertebrate) organs reverses the order of their appearance during ontogenetic and phylogenetic development. Another view widely held is the teleologic explanation that those organs persist longest which are most valuable to the organism or species. All such theories, however, appear inadequate to explain the facts observed. Runnström (for sea-urchin larvae) proposed a more rational theory, explaining the morphological changes upon the basis of the varying physico-chemical conditions in the starving organism. Future investigation along this line will probably give better comprehension of the phenomena involved.

The question may also be raised as to why the degenerative changes in the various cells during inanition are so similar, not only in the various types of total and partial inanition, but likewise in many other abnormal conditions, such as extremes of temperature, fatigue, toxic or electrical stimuli, etc. Various answers to this question are possible, but the most probable would appear to be that the effects are similar because these all represent conditions which obstruct the normal cell metabolism, thereby causing the same degenerative cell changes. The fundamental similarity in the cellular results of such varied conditions recalls the dictum of Cuénot that "la plupart des influences de milieu se ramènent en somme à des différences de nutrition."

Nutrition therefore becomes a factor of primary importance for morphology as well as for physiology. The form and structure of all living organisms are clearly dependent in large measure upon the quantity and quality of their nutriment. The effects of inanition of various types apparently account for many of the variations observed among living organisms, under both normal and abnormal conditions. A knowledge of these effects gives a deeper insight into the process of morphogenesis and a means whereby it may be experimentally controlled to a degree hitherto generally unrealized. Furthermore, even though it be contrary to the generally accepted biological doctrine, there is another possibility which must be considered. Not only the somatoplasm, but under certain circumstances even the germ plasm may perhaps likewise be modified by nutritional conditions, a possibility of fundamental significance for heredity and evolution.

CLARENCE M. JACKSON

A RESEARCH CAREER IN ASTRONOMY

WIDELY different types of investigation are now included in astronomy, and only the most general remarks would apply to all of them. For the student who is considering a professional career in astronomical research it may be useful to outline the various branches from the standpoint of the personal aptitudes of the investigator.

THEORETICAL ASTRONOMY

For the mathematically inclined there is the great field of theoretical astronomy. The theoretical astronomer is a mathematician who uses the principles of mechanics, for example, together with calculus, infinite series, etc., to achieve his purposes, as a carpenter uses hammer and nails. If the tools and materials are not properly handled the structure either never rises at all, or collapses the first time its strength is tested. Hence a thorough apprenticeship is essential. Typical problems with which the theoretical astronomer deals are the computation of orbits of comets, planets, satellites, meteors and double stars; the more general problems of celestial mechanics, such as the formation of stars and stellar systems, or the stability of rotating bodies; statistical inquiries concerning the structure of the universe; and, of growing importance, the application of theoretical physics and chemistry to celestial bodies.

The theoretical astronomer can get along without a telescope, but he needs a library and the assistance of computers. His usual position, therefore, is that of professor of astronomy at a college or university. He will ordinarily be expected to conduct classes, but at many institutions some research will be possible if he is sufficiently eager and persistent. The American student who is looking forward to work of this character should prepare to teach, as there are few theoretical astronomers in the United States who do not have duties of instruction.

OBSERVATIONAL ASTRONOMY

Astrophysics—For one whose interest is along the lines of physics and chemistry there is the expanding realm of astrophysics. This science is concerned with deriving all possible information from a study of the quality and intensity of the light received from the heavenly bodies. The observational goal of astrophysics is a complete knowledge of the spectral energy curves (including state of polarization) of the light radiated from every celestial source. The heart of the matter lies in the interpretation of these curves and here astronomy and physics blend. The three main divisions are spectroscopy, photometry, and radiometry.

Spectroscopy is the study of spectral details, *i.e.*, lines and bands, without special reference to the absolute intensities. This line of work has undergone a remarkably extensive development since the pioneer days of Secchi and Huggins. The chief subjects of research are chemical identifications, physical conditions, radial velocities, and intrinsic stellar luminosities (which when combined with apparent luminosities give distances). There are, of course, many special problems of great importance, in particular, those referring to the disk of the sun. It would take too much space even to outline the contents and value of the branches of astronomical spectroscopy, but nearly every school library contains a few books describing them. Miss Clerke's "Problems in astrophysics" and "The system of the stars," Hale's "Stellar evolution" and Campbell's "Stellar motions" may be mentioned.

Photometry has to do with the brightness and color of the stars, and is of value not only for the vast number of separate facts which have been gathered and which serve as essential aids to many investigations, but also for the general conclusions which may be drawn from its data. The science of star colors still remains in a rather crude form, however, and it is only a matter of time until the present methods will be largely superseded—at least for the brighter stars—by more complete and detailed methods of spectro-photometry. A most promising problem is the practical development and application of such methods.

Stellar radiometry, or the measurement of the radiation of the stars by the thermocouple or bolometer is in its infancy and has thus far consisted chiefly in observing the total, undispersed radiation. A few successful attempts have already been made, however, to adapt these instruments to stellar spectro-photometry, and it is certain that there is a fine future for this line of work.

The new science of stellar interferometry occupies an intermediate position between astrophysics and the astronomy of the measurement of position. Students who have a thorough acquaintance with the principles of optics and with laboratory interferometry are needed to develop this attractive field.

Astronomy, as a part of general physics, is capable of making important contributions to our knowledge of the properties of matter, of light and ether, and perhaps of the "nature of space." This prospect should attract the student whose ambitions are such as to lead him to devote himself to the type of work underlying the progress of science, even though his investigations may not find practical application in a month or a decade. There is a romantic appeal in the idea of studying the structure of the atom by observing objects invisible to the naked eye and so distant that light, which could encircle the earth seven times in a second, is hundreds of years in making the journey which ends on a human retina or on a photographic plate at the end of a telescope. With the aid of the mysterious but powerful "quantum" theory, knowledge of atoms and electrons and their relationships to light waves is progressing by leaps and bounds, and spectroscopic facts of all kinds are assuming an importance which was but dimly foreseen a few years ago. Properties of matter not yet exhibited in the laboratory can be studied in the stars by means of the spectroscope, but only a beginning has been made. It is doubtful whether space has any properties except those which are postulated into it, but perhaps the best way to talk about certain geometrical and physical relationships is to assume that space does possess objective properties. Our ideas of the relationship between space and ether are, at the present time, in an unsatisfactory state of profound confusion, the saving feature of which is that the foundations of physics are being scrutinized as never before. Much careful thought is required concerning these matters, and the investigator should be an astronomer, a physicist, and a mathematician combined in one.

Direct visual observation—To one who has keen eyesight and a fondness for making precise observations astronomy has much to offer. Double stars are discovered and measured visually. The determination of time and of the fundamental positions of reference stars depend on visual observations with meridian circles. Observation of the surface details of the moon and planets makes a strong appeal to some persons.

Photography—The taking of direct photographs of celestial objects, especially of comets and nebulae, is a never ending source of delight. Much interesting and profitable work of this kind can be done with telescopes having apertures from one to one hundred inches. Photography also serves for accurate position observations as in parallax and proper motion work and in star charting, and in recording solar and stellar spectra. In fact, photography is extensively used in so many types of work that the prospective observational astronomer should cultivate a thorough acquaintance with photographic operations and materials.

Nearly every type of work mentioned in this article, except stellar radiometry, can be successfully carried on with telescopes of moderate size, although in many instances the increased power of large telescopes is a great advantage. Worth-while investigations and fine work of a miscellaneous character can be done with apertures of twelve inches and less. The small and medium-sized telescopes in the United States are capable of being used for research to a far greater extent than is the case at present.

Observational astronomy is carried on at special research observatories and by departments of astronomy in academic institutions. Excellent graduate instruction in astronomy may be obtained in any one of ten or twelve colleges in the United States. The two largest research observatories in which there are regular arrangements for the admission of students are the Lick Observatory at Mount Hamilton, California, and the Yerkes Observatory at Williams Bay, Wisconsin. In several places there are graduate fellowships or assistantships which pay the living expenses of the holder while he is working for a doctor's degree.

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As a basis for a worth-while research career in astronomy, the student should have an insatiable curiosity concerning the secrets of the stars, and unbounded enthusiasm for personal investigation. Without these he would surely find an astronomical career unenjoyable, and it would probably prove unprofitable as well; but possessing these qualifications and fortified by sound technical preparation, astronomy may be the only life work which he could carry through without vain longings and regrets arising from a sense of stifled aspiration.

PAUL W. MERRILL
MOUNT WILSON OBSERVATORY

SCIENTIFIC EVENTS

EPIDEMIC DISEASE IN EUROPE

THE sixth number of the *Epidemiological Intelligence Bulletin* has just been issued by the health section of the League of Nations Secretariat. According to the summary in the London *Times*, it deals with epidemic diseases in Eastern and Central Europe from May to December, 1922, and treats in some detail typhus and relapsing fever, Asiatic cholera, dysentery, smallpox, plague, epidemic diseases of the central nervous system, malaria and enteric fever. The statements are based on the number of cases notified. Actual comparisons between countries are generally impossible. Briefly summarized, the comparison between 1921 and 1922, in so far as the reports have been received, is as follows:

The incidence of typhus and relapsing fever was fully twice as great in 1922 as in 1921 in Russia, another extremely high epidemic wave having occurred in 1921-22. This wave was quite double the 1920-21 wave, but was less than half as great as the second wave of 1919-20, judging from the number of cases reported. In Poland no improvement in 1922 over 1921 was noted for typhus and the prevalence of relapsing fever has greatly increased. In Latvia there was apparently an increase of typhus, but a decrease of relapsing fever.

With the exception of the Ukraine and the Russian Black Sea littoral, the cholera situation improved considerably in 1922. In Russia, exclusive of the Ukraine, the number of cases reported in 1922 was about one fourth of those reported for 1921 since the great epidemic in South Russia of 1921 had come to an end. In the Ukraine, however, a serious epidemic occurred in 1922; the number of cases in July (the highest month), 1922, was four times as large as in July, 1921. No serious epidemics were noted elsewhere.

Notifications of dysentery probably mean nothing more than certain intestinal infections with similar clinical symptoms, but the prevalence of the disease in 1922 was apparently considerably less than in 1921 in all the countries concerned. Even in Russia, for which the reports are extremely incomplete, there is no evidence of unusual prevalence.

Smallpox declined in 1922 in all countries where it was markedly prevalent during the preceding year, although its incidence was still high in Russia.

Malaria assumed more alarming proportions in Russia during 1922 and the situation was rendered even more serious by the appearance of the tropical type in Eastern Russia. The million and more cases actually reported for Russia represent a small proportion of the cases which must have actually occurred.

The incidence of enteric fever was less during 1922 than during the preceding year in nearly all European countries.

FELLOWSHIPS OF THE ROCKEFELLER FOUNDATION

DR. ALONZO E. TAYLOR, of Leland Stanford University, has recently returned from Europe where, in the capacity of financial and economic expert, he was assisting Dr. R. M. Pearce in his survey of conditions in medical education. In the following paragraphs we are giving a brief outline of his description of the situation in medical science in Germany and of the results which may be expected from the aid which has been voted by the Rockefeller Foundation for German medical scientific men.

Just after the war, according to Dr. Taylor, the number of students entering medical schools in Germany was unduly large; now, however, it has diminished to about one fourth of the pre-war number. There are still plenty of young men desirous of doing research and special work, but facilities for such work are regrettably lacking. Buildings and basic equipment, it is true, are still effective, but current supplies—animals, instruments, chemicals and so forth—are prohibitive in price. The continuity of German science is, therefore, threatened in its quality and not for lack of men desirous of devoting themselves to the work.

The gift of the foundation for scholarships and fellowships in Germany Dr. Taylor considers the most important constructive assistance given Germany since the war. It will, he believes, have the double effect of aiding medicine and strengthening the influence of liberalism throughout the country. According to present plans it is probable that one hundred fellowships will be in active force by the first of February and one hundred more will be granted during the course of the next six months.

A total of 226 fellowships were granted during 1922 by the foundation and its various boards. Of these, seventy-nine were fellowships in public health administered by the International Health Board, twenty-two were under the Division of Medical Education, sixty-three under the China Medical Board and sixty-two were fellowships in physics, chemistry or medicine, supervised by a committee of the National Research Council. These fellows represent the following countries: Austria, 3; Australia, 3; Brazil, 20; Canada, 12; Ceylon, 1; China, 14; Costa Rica, 1; Colombia, 2; Czechoslovakia, 16; Great Britain, 9; Hungary, 3; Japan, 2; Jugoslavia, 2; Mauritius, 1; Mexico, 1; Nicaragua, 3; Norway, 1; Philippine Islands, 4; Poland, 10; Salvador, 1; Siam, 2; Syria, 3; United States, 111.

CHEMISTRY-COMMERCE COURSE AT THE UNIVERSITY OF WISCONSIN

THE growing importance of chemistry in modern commerce has brought about a condition which makes desirable the offering of a four-year university course in which the student may get the essentials of a commercial training, together with an amount of chemical training sufficient to enable him to understand the basic technical features of the industries with which he will come in contact.

The University of Wisconsin, realizing the necessity for such training, has established a new four-year course to be known as the chemistry-commerce course and which will be open to prospective students at the beginning of the school year 1923-24, in September. This course is intended particularly for men who desire to fit themselves to hold commercial positions such as business managers, technical secretaries, managerial secretaries, purchasing agents, technical salesmen and, in fact, any commercial position in which a thorough understanding of fundamental chemical principles would be an asset.

Men of affairs in the industrial world are often seriously handicapped because they do not possess a fundamental knowledge of the technical principles involved in their business. Each year it becomes more and more important for the business man to have a knowledge of the chemistry of the processes with which he is concerned. As our civilization advances and becomes increasingly complex, the successful application of sound chemical principles becomes increasingly important. While it is true that the business man may hire chemists or chemical engineers to develop the technical details of his business, it is equally true that he will be greatly handicapped unless he himself knows enough chemistry to be able to talk intelligently with these men. Without a fundamental knowledge of chemistry, their reports will mean but little to him and there will not be the sympathetic understanding which should exist beween the executive office and the technical department. We are now living in a chemical age and the business man who has neglected to acquire a knowledge of fundamental chemical principles is in the same boat with the farmer who continues to use the methods of fifty years ago.

In addition to certain required courses in chemistry, economics, mathematics, foreign languages and English, a considerable number of free electives have been provided, so that the student may broaden his education in the direction he sees fit.

The course in commercial chemistry which runs throughout the junior year is not a course dealing with the engineering features in industrial chemistry. The students taking this four year course are interested primarily in the economic or commercial aspect of the subject, rather than the purely technical. Only so much of the technical will be given as is necessary for a background. It is the intention to give the student a wide acquaintance with commercial processes and materials of commerce, rather than a detailed, technical knowledge of a few. For those who desire a more technical treatment, courses in industrial chemistry will be open for election. In discussing processes and products, the emphasis will be placed on the chemistry and the economic conditions which determine the value of the process. Such subjects as the location of a plant with respect to all the factors involved will be especially emphasized. The cost of transportation of both raw and finished products will be studied. Each student will make a special detailed study of one typical plant and will turn in a report of his findings. Market reports will be analyzed and those factors which influence the fluctuation in chemical markets will be taken into consideration. The course may properly be called a "Survey of the field of commercial chemistry" and will interpret the rôle played by chemistry in commerce.

J. H. Mathews
Director

STANDARDIZATION OF TRAFFIC SIGNAL COLORS

Forty-two men, representing the manufacturers and users of traffic signals, federal and state governmental departments, associations interested in the prevention of traffic accidents and representatives of the general public, are now at work on the drafting of a national code on the proper colors for traffic signals, which it is expected will not only cut down the annual loss of life through traffic accidents, but will eliminate many of the existing irritations to motorists and to the operators of steam and electric railways.

This work is being carried on under the auspices of the American Engineering Standards Committee, whose approval of a code or standard insures its ultimate acceptance and observance throughout the country. The American Engineering Standards Committee is composed of seven departments of the United States Government, the principal technical, industrial and engineering societies and individual business concerns interested in standardization.

The sectional committee drafting this code is made up of seven representatives of the manufacturers of traffic signals, nine representatives of the purchasers of such equipment, three representatives of the users of traffic signals, twelve representatives of governmental bodies, five technical specialists and six insurance representatives.

Charles J. Bennett, state highway commissioner of Connecticut, who represents the American Association of State Highway Officials, has been selected chairman of the sectional committee. M. G. Lloyd, of the United States Bureau of Standards, who is the representative of both the bureau and the American Society of Safety Engineers, is vice-chairman, and Walter S. Paine, research engineer of the Aetna Life Insurance Company, who is the representative of the National Safety Council, is secretary of the sectional committee.

THE LIBRARY OF WILLIAM JAMES

More than a thousand books from the private library of William James, who taught psychology and philosophy at Harvard University from 1872 to 1907, a large number of which contain marginal notations by him, have been presented to the university by his family. The collection is considered by Harvard library officials to be of unique interest and value to future students of the philosophical thought of William James and the group of philosophers about him.

An important part of the collection consists of about 400 volumes, almost all of which have to do with philosophy, psychology and the moral sciences; these books have been selected, with the counsel and assistance of Professor Ralph Barton Perry and Dr. Benjamin Rand, of the philosophical department at Harvard, because of the unusual interest attaching to the annotations by Professor James which appear in them. They contain numerous marginal comments and interlineations, mostly in pencil, which throw light on the development of James' philosophical ideas and on the influences which shaped his thought.

There is another group of about 600 volumes, some of which have to do with psychical research, spiritism and abnormal psychology and some with the religious emotions, religious biography and topics touched on in James' "Varieties of religious experience." This second group is interesting as a collection because many of the books are not easily obtainable or are not ordinarily classified in library catalogs under the subjects to which Professor James related them.

Still another group consists of about fifty philosophical and religious books used by Professor James and containing annotations by his father, the Reverend Henry James. These books would be of special interest to students of the sources and influences of James' work.

Finally there are about twenty books, somewhat annotated, which the philosopher placed together shortly before his death with the intention of working up the subject of military psychology.

The collection as a whole is being transferred to the Harvard University Library, where arrangements will be made to place the books of the first group in the "Treasure Collection," where they will be accessible only to those qualified to consider and respect the marginal notations.

THE SWARTHMORE CHAPTER OF SIGMA XI

ON the afternoon of April 27, there was installed at Swarthmore College a new chapter of the society of Sigma Xi, to be known as the Swarthmore College Chapter. The ceremonies of installation were in charge of President Henry B. Ward, of the National Society, assisted by the national secretary, Edward Ellery. Delegates were present from the chapters at the University of Pennsylvania and at Rutgers College. The new chapter was initiated with twelve charter members, seven of whom were already members of the society. Unusual interest attaches to the establishment of the Swarthmore Chapter in that it has been a distinct departure from the previous policy of the organization that a charter has been granted to a group in an undergraduate institution. The chapter begins its activities under the following officers: *President*, John A. Miller; *vice-president*, Spencer Trotter; *secretary*, Winthrop R. Wright, and *treasurer*, Errol W. Doebler.

After the installation the national officers, the delegates, the chapter and the faculty and managers of the college were the guests of President and Mrs. Aydelotte at a reception held in their home. Following this reception a public address was given by President Ward in Collection Hall. Dr. Ward prefaced his address with a brief statement of the ideals and the achievements of Sigma Xi in encouraging and producing research and of the uniqueness of its position among the so-called honor societies. His address was entitled "On the trail of the Alaska salmon" and was illustrated with photographs secured by him during an investigation in the interest of the conservation of food supply.

The ceremonies were concluded with a dinner in the evening which was attended by about one hundred members and guests. The toastmaster, Ex-governor William C. Sproul, was introduced by President Aydelotte, who took this occasion to welcome the new chapter on behalf of the administration and to pledge the support of the college for the ideals of Sigma Xi. The principal address was made by Dr. A. L. Day, director of the Geophysical Laboratory, on "The approaches to research." Brief remarks were also made by Dr. C. E. McClung, past-president of Sigma Xi, Secretary Ellery, Ex-provost Edgar F. Smith of Pennsylvania and President Miller. The festivities of the evening were closed by President Ward, who wished God-speed to this, the youngest and smallest of Sigma Xi's chapters.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE K. BURGESS has been appointed director of the Bureau of Standards to succeed Dr. S. W. Stratton, who resigned to become president of the Massachusetts Institute of Technology. Dr. Burgess has been connected with the Bureau of Standards for twenty years, becoming chief of the division of metallurgy in 1913.

AT a meeting of the executive board of the National Research Council held in Washington on April 24, officers were elected as follows: Chairman of the executive board, Gano Dunn; first vice-chairman, president of the National Academy of Sciences (A. A. Michelson); second vice-chairman, Charles D. Walcott; third vice-chairman, Robert A. Millikan; fourth vice-chairman, John C. Merriam; members at large of the executive board are H. E. Howe, Raymond Pearl, M. I. Pupin and William H. Welch. Dr. Vernon Kellogg is the permanent secretary of the council.

THE gold medal of the National Institute of Social Sciences was conferred on Dr. Charles B. Davenport on the occasion of the ninth annual dinner on April 25.

THE University of Edinburgh will confer the honorary degree of doctor of laws on Sir Charles A. Parsons and Mrs. Henry Sidgwick.

DR. H. H. DALE, head of the department of bio-chemistry and pharmacology of the Medical Research Council, has been elected a member of the Athenæum Club of London for eminence in science.

THE Jacksonian Prize of the Royal College of Surgeons of England for the year 1922 on "The effects produced by radium upon living tissues, with special reference to its use in the treatment of malignant diseases," has been awarded to H. Sidney Forsdike, of the Soho Hospital for Women.

WE learn from *Nature* that the British Institution of Mining and Metallurgy has made the following awards: The gold medal of the institution to Mr. Edgar Taylor, president, 1909-1911 and 1916-1918, in recognition of his services to the institution since its foundation in 1892 and as an evidence of appreciation of his honorable record of work in connection with the development of the mining industry, particularly in India; "The Consolidated Gold Fields of South Africa, Ltd." gold medal to Dr. Leonard Hill, in recognition of his valuable researches on ventilation and for his paper on "Ventilation and human efficiency," contributed to the *Transactions;* and "The Consolidated Gold Fields of South Africa, Ltd." premium of forty guineas to Mr. H. F. Collins, for his paper on "The igneous rocks of the Province of Huelva and the genesis of the pyritic ore-bodies," contributed to the *Transactions*, and in recognition of his researches on the subject.

THE Carthage biennial prize, founded in 1921, has been awarded for the first time to Dr. Nicolle, for his researches on the transmission of typhus and on trachoma, Malta fever, leishmaniasis and other tropical diseases.

PROFESSOR THEODORE J. STOMPS, of the University of Amsterdam, writes that a *bas relief* of Professor Hugo de Vries has been made by one of the best artists and may be had for $20. It is of plaster and natural size. A bronze medal 7 c.m. in diameter may be obtained at the same price. Orders may be sent to Professor Stomps.

A. W. AMBROSE, assistant director of the Bureau of Mines, resigned recently to become associated in an executive capacity with the Empire Companies, with headquarters at Bartlesville, Okla.

DR. CARL D. LA RUE, instructor in botany in the University of Michigan, has accepted an appointment for a period of one year as specialist in rubber investigations in the Bureau of Plant Industry, Washington, D. C. Dr. La Rue was formerly botanist to a Dutch company in Sumatra.

DR. LUDVIG HEKTOEN, of the John McCormick Institute of Infectious Diseases, has been elected a director of the John Crerar Library in Chicago.

ETHELBERT STEWART, commissioner of labor statistics, United States Department of Labor, has been appointed the representative of that department on the American Engineering Standards Committee, with Lucien W. Chaney, of the Bureau of Labor Statistics, as alternate.

PROFESSOR D. L. VAN DINE, of the Agricultural Extension staff of Pennsylvania State College, has been appointed one of the scientific trustees of the Tropical Plant Research Corporation, a newly formed organization. The objects of this corporation are to promote research for the advancement of knowledge of the plants and crops of the tropics.

IN the College of Engineering and Architecture of the University of Minnesota, Professor J. J. Flather, mechanical engineering, and Professor W. H. Kirchner, drawing and descriptive geometry, have been granted sabbatic leave of absence for the year 1923-24. Professor Flather expects to spend the year at the University of California; Professor Kirchner will travel and study in Europe.

CHESTER K. WENTWORTH, instructor in the department of geology at the University of Iowa, has been appointed to a Bishop Museum fellowship by Yale University for the academic year 1923-24, which will give him the opportunity of a year of field study of volcanic ash and other pyroclastic sediments of the Hawaiian Islands. Mr. Wentworth will leave for Honolulu about September 15.

EUGENE VAN CLEEF, assistant professor of economic and social geography and chairman of the Foreign Trade Division, College of Commerce, Ohio State University, will sail on June 7 for Finland. He will study Finnish life as it may reflect the influences of its physical environment and will compare these observations with similar ones made among the Finns in America.

AT the University of California leave of absence for the purpose of travel and study have been granted as follows: G. N. Lewis, professor of chemistry and dean of the College of Chemistry, will serve as the representative of the United States in the International Union of Pure and Applied Chemistry. He will also deliver addresses before the British Association, the Faraday Society and other scientific meetings to be held in Europe. B. L. Clark, assistant professor of paleontology and director of the museum of paleontology, will complete the mapping of the geology of Mt. Diablo Quadrangle, for the United States Geological Survey. D. R. Hoagland, associate professor of plant nutrition, proposes to spend several months in England at the Universities of Liverpool, London and Cambridge and at the Rothamsted Station. An additional period of several months will be spent in France and Italy, followed by an inspection of experiment stations and other institutions of the United States. A. Smith, assistant professor of soil technology, will conduct studies under the direction of Dean Russell and Professor Whitson at the University of Wisconsin.

DR. C. L. SHEAR, of the Bureau of Plant Industry, United States Department of Agriculture, who was recently placed in charge of the plant disease survey and pathological collections of the bureau, sailed for Europe on May 5. He will represent the United States as one of its delegates to the Pasteur Centennial Celebration to be held in Paris May 26 to June 1 and attend the International Congress of Agriculture at Paris and the International Conference of Phytopathologists in Holland as a delegate for the American Phytopathological Society. He will also make a study of international pathological problems and secure material for the pathological collections of the department.

DR. R. A. MILLIKAN, of the California Institute of Technology, addressed the Physics Club of the Bureau of Standards on April 18, on "The penetrating radiations of the upper air."

PROFESSOR EMERITUS H. L. FAIRCHILD, of the University of Rochester, addressed the students of geology in Lehigh University on Saturday, April 28, describing the development of the drainage systems of New York State.

DR. MICHAEL F. GUYER, of the University of Wisconsin, lectured at Emory University on May 3.

DR. ALBERT KUNTZ, of the St. Louis University School of Medicine, gave a lecture at the State University of Iowa on April 26 under the auspices of the Baconian Club on "The enteric nervous system and the nervous control of gastric and intestinal motility."

SIR ARTHUR KEITH has been elected Vicary lecturer of the Royal College of Surgeons of England for the ensuing year.

AT King's College, London, four lectures commemorating the tercentenary of the birth of Blaise Pascal are to be given by Professor H. Wildon Carr.

THE senate and the board of trustees of the University of Chicago have recommended the establishment of a memorial at the University of Chicago to the late Dean Rollin D. Salisbury, of the Ogden Graduate School of Science, who was also head of the department of geology at the time of his death last August. The committee appointed to decide upon an appropriate memorial includes Mr. T. E. Donnelley, of the board of trustees, as chairman; Professor Harlan H. Barrows, head of the department of geography, vice-chairman, and Professor Edson S. Bastin, who is chairman of the department of geology. Dean Salisbury was connected with the university from its founding in 1892 until his recent death.

DR. SCHUYLER SKAATS WHEELER, president of the Crocker-Wheeler Company of New York and Ampere, N. J., distinguished as an electrical engineer, died in New York City on April 20, aged sixty-three years.

DR. FREDERICK SALATHE, chemist and oil geologist, died at Santa Barbara, Calif., on May 1, aged fifty-seven years.

DR. JAMES MACFARLANE WINFIELD, professor of dermatology in the Long Island Medical College, died on April 24, of injuries received when he was run down by a motor car in Brooklyn. Dr. Winfield was in his sixty-fourth year.

A CORRESPONDENT writes: "Dr. John McLaren McBryde, president emeritus of the Virginia Polytechnic Institute, died in New Orleans, La., March 20, at the residence of his son, Dr. J. M. McBryde, Jr., of Tulane University. Dr. McBryde, who was in his eighty-third year, retired from active service in 1907, when he was granted a retiring allowance by the Carnegie Foundation for the Advancement of Teaching. During his academic career he was a professor at the University of Tennessee, president of the University of South Carolina, president of the Virginia Polytechnic Institute and was the first director of the South Carolina Experiment Station, also director of the Virginia Experiment Station. He was elected the first president of the University of Virginia, first president of Sweet Briar College for Women, president of the University of Tennessee and was offered the post of assistant secretary of agriculture under President Cleveland, but declined all of these offers."

PROFESSOR A. C. BURRILL has resigned as extension entomologist of the University of Missouri to accept a position as curator with the Missouri Resources Museum Commission in the new State Capitol Building, Jefferson City, Missouri. A correspondent writes: "The recent session of the Missouri Legislature has consolidated the work of a formerly delayed attempt to found a historical museum, given over previously to the soldiers and sailors for a flag exhibit and paintings of war scenes with a newly financed scheme for a resource museum devoted to Missouri. The campaign for retrenchment by the last legislature will make this biennium one chiefly of planning exhibits and installing cases for such exhibits as the commissioners wish to start. It is intended that this museum shall sound both the historical and conservational note with regard to Missouri. Since certain groups failed to get either a state pest and plant service, a state forestry commission, a state park system or a state waterways commission in the recent session, it may be logically concluded that the present legislature is now in favor of attempting exhibits along these lines from which the general public will be asked to draw its own conclusions as to what further developments Missouri needs. There are many people outside of Missouri interested in the progress of the state and its resources whose opinions and suggestions will be welcome to the commission."

A SOLAR observatory is to be erected on Mount Stromlo in Canberra territory to link up with institutions in England, India, America and Europe. The British Astronomer Royal and Professor Turner, of Oxford, have been asked to act with Professor Duffield, of University College, Reading, who is now in Australia, in the selection of a director. An opportunity will be given to the director to visit European and American observatories.

THE Florida House of Representatives has passed by a two thirds vote a resolution condemning the teaching of evolution in any tax supported institution of the state. It is expected that the same resolution will pass the Senate. The text of the resolution (omitting the preamble) is as follows: "Resolved, that it is the sense of the legislature of the state of Florida that it is improper and subversive to the best interests of the people of the state for any professor, teacher or instructor in the public schools of the state, supported in whole or in part by public taxation, to teach or permit to be taught atheism, agnosticism, Darwinism, or any other hypothesis that links man in blood relation to any form of life."

THE United States Civil Service Commission announces that it will hold an examination on May 23 to obtain candidates for a position on the editorial staff of the United States Geological Survey. The salary offered is $1,800 to $2,400. The examination will include tests in editing technical manuscript, to be weighted 50 per cent.; printing and proofreading, 30 per cent., and correction of errors in footnotes in foreign languages, 5 per cent. In addition a weight of 15 per cent. will be given for scientific education and practical experience. Further particulars concerning the examination can be obtained from the Civil Service Commission or from the editor of the Geological Survey at Washington.

THE Palmolive Company of Milwaukee announces the establishment of a fellowship for the study of the fundamental principles connected with the detergent action of soap. The fellowship carries an annual stipend of $2,000. The fellow will have the privilege of pursuing his studies at any institution in the country which is properly equipped for this purpose. The candidate must possess the equivalent of a master's degree. The fellowship will be awarded by a committee consisting of the following: W. D. Bancroft, professor of chemistry, Cornell University; E. C. Franklin, president American Chemical Society; H. N. Holmes, chairman Colloid Division, National Research Council; Victor Lenher, professor of chemistry, University of Wisconsin, and J. C. Sellner, representing Palmolive Company. Application should be made to Victor Lenher, chairman, Palmolive Fellowship Committee, P. O. Box 281, Milwaukee, Wisconsin.

A RECENT Act of Congress authorizes the Regents of the Smithsonian Institution to prepare preliminary plans for a suitable fireproof building with granite fronts, for the National Gallery of Art, including the National Portrait Gallery and the history collections of the United States National Museum.

WE learn from the *Journal* of the American Medical Association that the Rockefeller mission has completed five years of its active propaganda against tuberculosis in France, and has handed over its services and its activities to the Comité national de défense contre la tuberculose in Paris. The work is in charge of M. Léon Bourgeois and of Professors Calmette and L. Bernard and is carried on in the same way by lectures, motion pictures and other means.

THE will of the late D. Blakeley Hoer, of Brookline, Mass., provides that after the death of various beneficiaries the principal and income from his estate shall be used for acquiring land, preferably on the watershed of the Charles River, for the cultivation of forests thereon forever. The land is to be used for the production of lumber and for bird preserves. Useful birds, especially those feeding on insects injurious to trees, are to be protected always. When the forests become a source of profit, out of the net income 5/15th of the net income is to go to the town of Brookline for its high school; a similar portion to the Brookline public library; 4/15th is to go to Brookline to plant trees and shrubs along or near the streets and 1/15th to Beth Horen Lodge, A. F. and A. M. of Brookline.

THE joint committe recently appointed by the American Society of Mechanical Engineers has decided to accept the offer of the Smithsonian Institution to establish at Washington, D. C., a central historical museum of engineering, in connection with which local branches will be developed in other sections. The museum will be a storehouse for records of American engineering achievements. It will afford opportunities for research and investigation. The plan has obtained the cooperation of the Federated American Engineering Societies, from which body the joint committee was selected by the American Society of Mechanical Engineers. The Smithsonian Institution, in offering to act as custodian of collections, urged that the movement be broadened from an engineering society standpoint to that of a national museum. This idea was acceptable to the engineers and the museum will be founded on the broadest possible basis.

A CONVENTION between the United States and Great Britain for the preservation of the halibut fishery of the north Pacific Ocean, including Bering Sea, was signed March 2 and on March 4 it was ratified by the senate. The chief feature of the convention is a close season on fishing for halibut, both in territorial waters and on the high seas off the western coast of the United States and Canada, from November 16 to February 15 following, both days inclusive. It is provided also that within two months after the exchange of ratifications an International Fisheries Commission, consisting of four members, shall be appointed, two from each country. This commission is to investigate the life history of the Pacific halibut and make recommendations to the two governments as to any regulations that may seem to be desirable for the preservation and development of the halibut fishery. The convention is to continue in force for a period of five years and thereafter until two years from the date when either of the high contracting parties shall give notice to the other of a desire to terminate it.

UNIVERSITY AND EDUCATIONAL NOTES

DR. JAMES A. PATTEN, of Chicago, has given $50,000 to Monmouth College, at Monmouth, Illinois. Mr. Patten's donations to the college now amount to $133,000.

APPLICATION has been made to the Ontario legislature to amend the act of incorporation, changing the name of Western University Medical School, London, to the University of Western Ontario, the desire of the authorities being to make this university the educational center of the western part of the province.

J. A. HILL, wool specialist of the University of Wyoming Agricultural Experiment Station, has been elected dean of the Wyoming College of Agriculture and director of the Wyoming Experiment Station.

DR. CLIFFORD I. CARPENTER, Dr. Arthur W. Thomas and Dr. J. Enrique Zanetti, assistant professors of chemistry in Columbia University, have been promoted to the rank of associate professors.

DR. KIMBALL YOUNG, appointed this year assistant professor at Clark University, will return to the University of Oregon in September to teach social psychology and anthropology.

DR. ROBERT L. PENDLETON, for some years director of the department of agriculture, Gwalior State, India, has been appointed professor of soil technology in the College of Agriculture, Los Banos, Philippine Islands.

DR. J. S. ANDERSON, of the helminthological department of the London School of Tropical Medicine, has been appointed to the chair of medicine at the University of Hong Kong.

DISCUSSION AND CORRESPONDENCE

ERYTHRODEXTRIN IN MAIZE[1]

DR. WEATHERWAX has found that the endosperm of Chinese waxy maize when tested with a solution of iodine dissolved in aqueous potassium iodide gives a red color reaction instead of the characteristic violet color of starch. From this phenomenon he infers that the endosperm of waxy maize is composed not of starch but wholly of a relatively rare substance, erythrodextrin. In a criticism of Weatherwax's paper East[2] questions the propriety of designating this substance erythrodextrin based solely on its color reaction and possibly there is justification for his position. This difference of opinion, however, must not be allowed to obscure the fact that the endosperm of waxy maize can be differentiated from the endosperms of all other known types by its color reaction when treated with iodine solution and whether Weatherwax's contention is substantiated or not will not materially affect the value of his discovery which remains as a distinct contribution to the genetics of maize.

The iodine test has made possible the identification of the double recessive combination of waxy and sweet obtained in the F_2 of hybrids between the waxy type and varieties of sweet corn. This double recessive combination completely resembled sweet seeds in contour and could only be determined by subsequent breeding tests. The iodine method has been of value also in separating the waxy from the starchy seeds in hybrids with the large-seeded Cuzco variety where heretofore classification has been impossible owing to the looseness of the carbohydrate particles.

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[1] Weatherwax, Paul. A rare carbohydrate in waxy maize. *Genetics*, 7, 568-572, 1923.

[2] East, E. M. Weatherwax on maize endosperm. SCIENCE, LVII, No. 1475, pp. 416-418, April 6, 1923.

The fact must not be overlooked, however, that the identification of the carbohydrate as erythrodextrin does not furnish a complete explanation of the physical properties of waxy endosperm since like starch this carbohydrate can be found in an extremely floury condition.

The chief criticism of this latest contribution of Weatherwax to the literature of maize and it applies equally well to several of his previous papers has been epitomized aptly by East in his phrase "blending of the didactic and the dogmatic" but this manner of presentation of course is purely personal and should not detract from the observed facts.

A more serious defect and one also not unique in this paper on erythrodextrin is a tendency to magnify the importance of minor discoveries.

This tendency is well illustrated by the extended discussion of the genetic difficulties met with in sweet-starchy maize hybrids—difficulties which hardly can be solved by the discovery that waxy endosperm turns red in a solution of iodine—and the discussion of this subject might well have been postponed until a true chemical solution could be offered.

Appreciating that there was to be a delay in publication Dr. Weatherwax kindly furnished us with a copy of his manuscript early last May and at that time his statement that "the sporadic appearance of sweet corn as a mutant from starchy corn in many parts of America is known" was questioned. Since he has not found it expedient to qualify this statement it seems desirable to record that as far as we are aware no such mutations are known to geneticists. In the thousands of guarded pollinations that have been been made in starchy maize varieties in the past decade not a single instance of a mutation to sweet seeds has been reported. While the value of the discovery of the red reaction of waxy endosperm in iodine solution can not be affected by the truth or falsity of this observation, it seems unfortunate that such a statement should be published under circumstances likely to afford it credence.

J. H. KEMPTON

BUREAU OF PLANT INDUSTRY

THE PERSONAL EQUATION AND REACTION TIMES

THE question whether personal equation in star transits is a matter of reaction time may be one that has been somewhat confused by not using the respective terms with the same significance.

But perhaps the real difficulty has been in the interpretation of the particular form of personal equation in this case. The usual understanding of recorded chronograph transits is based on the explanation given in books on descriptive astronomy, in which the observer is represented as tapping the key in coincidence with the instant when a star is on the wire, as nearly as he can do so. The flying bird and a sportsman, armed with a gun, is the popular illustration. Thus for a Mallard, dropping into decoys, we allow a lead of a yard, while for the Black Brant, commonly called a goose in California, we lead ten feet, because he is flying high and his size makes his real speed very deceptive.

My own habit of observing, however, based upon early consultation with such masters in the "old astronomy" as Benjamin Gould and Lewis Boss, has been to tap the key when I see the star on the wire. Thus every record is late and consciously late, but the advantage is that accidental deviations from uniformity of record are presumed to be smaller than they would be in efforts to allow for the motion of the stars as they approach the wire, each with a special velocity.

The systematic error thus introduced is a part of the personal equation and would be of importance in the determination of absolute clock corrections and in longitude work. It is eliminated in the measures of right ascensions where the observed clock correction and clock rate depend upon observations of standard stars. We are there concerned in making the accumulated accidental errors of observation as small as possible.

My own understanding of the reaction time in this process is the elapsed interval between the instant when the eye perceives the star to be on the wire, and the record of that perception by the finger with the key. Any estimate of coincidence based on judgment of speed or time interval does not enter. This estimate would appear to be the "synchronization of reactions and anticipated stimuli." Or, is an agreement to be prevented by the obstacle of a mutual understanding of familiar phenomena with a misunderstanding of the words in which they are described. In this freely translated "classical definition" of psychological descriptions I certainly do not wish to be understood as concurring.

Without pretense of undue modesty in the matter the conclusion established in my note in SCIENCE was not presumed to be a novel one in the domain of psychology. But the form of the test appears to be new, the comparison of the hourly rate of a clock at night with the daily rate at the epoch; and then only new as regards its completeness and the elimination of systematic errors as fully as possible. The tabulated results are not an exposition of the personal equation nor of reactions. They give the mean deviations of my personal equation from uniformity, and while fatigue is acknowledged to be existent it has introduced no mean deviation as large as the one-hundredth of a second in the intervals of two hours each. If these results, in their completeness and precision, contribute to the establishment of facts that are of interest to psychologists, that seems to be a matter of our mutual benefit.

R. H. TUCKER

LICK OBSERVATORY,
UNIVERSITY OF CALIFORNIA

We find in the psychological laboratory that there are two quite distinguishable conditions for reaction to a visual stimulus. Under one condition, which we have conventionally described as "simple reaction," the stimulus appears suddenly, at a moment which the reactor cannot predict, although he is given a "warning signal" preceding the stimulus by the period of from 1¼ to 1¾ seconds, understanding fully that the foreperiod is thus variable. The reactor's attention is thus approximately at its best during the short period of time within which the stimulus may actually appear. Under such conditions the average value of the reaction time should be from 130 to 160 *sigma*, varying in accordance with factors such as the type of individual, the amount of previous practice, etc. The average may, under certain conditions, have a value somewhat greater, but if over 180 *sigma*, we at once suspect serious error in the technique of obtaining and measuring the reactions, and even under the best conditions, with experienced reactors, an average of less than 120 *sigma* is unusual. The distribution of the individual reactions is, however, wide and a mean variation of not over 10 per cent. of the average is considered a safe measure of reliability. On this account, from 100 to 500 reactions are required to establish a valid average for a given reactor under given conditions.

The second condition for reaction (which is found in the so-called "complication experiment") is that in which the reactor sees the stimulus-pattern changing at a uniform rate towards an expected stage at which it constitutes the "stimulus." For example, he sees the star approaching the cross-wire in a transit instrument, or a pointer approaching a given mark on a dial; and the coincidence of star and cross-wire, or pointer and mark, constitutes the "stimulus." Under this condition, two different types of reaction are obtained: (*a*) When the reactor attempts to make his reaction *synchronous* with the stimulus pattern. In this case the reaction may actually follow or may precede the stimulus-pattern when seeming synchronous, but the positive or negative error usually varies from a few *sigma* to 30 *sigma*. (*b*) When the reactor may definitely attempt to make his reaction *follow* the stimulus pattern. Even in this case, although the reactor may succeed in making his "error" positive, it is usually relatively small; that is to say, only a fraction of the normal "simple reaction" time. In other words, the conditions here are those described under the first type (*a*) but with a subjective "set," which makes the error positive. This, however, is only one type of condition which will give a positive rather than a negative error in reactions of the "complication" type. It is not necessary that the estimation of the course of change in the stimulus-pattern should be consciously made. In fact, the actual stimulus-pattern for any reaction under such circumstances involves a temporal factor whether the reactor analyzes the temporal factor or not.

Whether a certain group of reactions to a visual stimulus are of the "simple reaction" or the "complication" type can usually be decided from the average value, even where the conditions of reaction are not fully described. If the average is over 120 *sigma*, the reactions were mostly of the "simple reaction" type, although (if we do not know all the conditions) we can not be assured that some reactions of the other type may not have been mixed in. If, however, the average is under 50 *sigma*, we can be certain that the reactions were practically all of the "complication" type, since the "simple reaction" will seldom occur if conditions are such that the "complication" reaction can occur, and is occurring in the majority of cases.

With these facts in view, it seems to me that there is no room for confusion between the conceptions of the psychologist and those of the astronomers.

KNIGHT DUNLAP

THE JOHNS HOPKINS UNIVERSITY

ÆROBIC?

DR. W. W. KEEN'S objection to the word "erobic" (SCIENCE, March 23, p. 360) is perfectly valid. However, the substitute he proposes is equally objectionable. The Greek word is ἀήρ. Like most of our Greek words this comes to us through the Latin transcription, in this case aër, formerly written with a dieresis. Now that the dieresis is no longer in vogue, some confusion is apt to occur. At any rate, the word is a dissyllable and not a diphthong. Dr. Keen would not propose the use of a diphthong in the words aerate, aerial, aeronaut, etc.

ARTHUR W. DOX

DETROIT, MICHIGAN

TO THE EDITOR OF SCIENCE—Dr. Dox surely has misread my letter in SCIENCE protesting against "erobic." I urged the retention of the "aer" as a disyllable. Personally I should use the diacritical mark to indicate the proper pronunciation.

The dropping of all accents in French by the newspapers during the war is wrecking their pronunciation, *e.g.*, "Poincaré" is often pronounced "Poin-car" or "Poin-care" and "communiqué" is distorted into "communeek" or even "communeek-quee."

If Dr. Dox will consult the Oxford Dictionary he will find that "disyllable" with one "s" is preferable to double s and that "dipthong" is an obsolete form of "diphthong" which in Greek is spelled with φ and θ (ph and th).

W. W. KEEN.

QUOTATIONS

PARK CONSERVATION

No one can justly charge the American Association for the Advancement of Science with flightiness, or suspect it of being swept off its feet through unpractical sentimentalism. Its strong plea to the governments and people of the United States and Canada that the great wild parks of both countries be more completely safeguarded against commercial exploitation of every form will, therefore, command attention and respect. The resolutions that the association has now issued upon this subject would seem to indicate that it recognizes the threatened encroachment of power developments within the national parks of both countries. Its appeal is not addressed to this particular menace alone, however, but calls attention to the fact that the parks are in many cases open to incursion by those who regard their various natural resources with covetous eyes. Gradually the public is coming to understand that the national parks are by no means as proof against materialistic raids as had been supposed. This call for a greater degree of protection, coming as it does from one of the most distinguished scientific organizations in the world, will tend to emphasize the situation and carry conviction as to its economic importance.

It will not be suspected that this association is unsympathetic with the endeavors of those who are legitimately developing the resources of the two countries. There is more than an implication in its resolutions, though, that it would be poor business to allow the material resources of the parks to be utilized except in those cases where a compelling and unquestionable public necessity exists. To safeguard the parks more thoroughly against unnecessary utilitarian developments, the association recom-

mends that the governments of the United States and Canada amend existing laws and secure such new enactments as may be needed to afford complete conservation to all units of what it terms "a unique continental exposition of inestimable value to science and to the popular education of future generations."
—*Boston Evening Transcript.*

SCIENTIFIC BOOKS

Exercise in Education and Medicine. By R. TAIT MCKENZIE, M. D., director of physical education, University of Pennsylvania. The W. B. Saunders Company, Philadelphia, 1923.

Here is a book published by the W. B. Saunders Company of Philadelphia that quite delights us. The author has the courage of his convictions and has dared to put forward as the main title of his book that good virile word exercise—from the Latin exercitium, which originally meant "to drive out," "drive on," "set at work." The derived meanings of this word are full of significance at the present time: "to set in action," "to give employment to," "to school or train"; and consequently "to exert for training or improvement" and "to improve by practice" or "to perform for training."

At an age when the would-be leaders of men and creators of public opinion are playing to the intelligence of the lowest mentality for the sake of reaching the largest numbers, is it not time to call a halt to the descent to moral mushiness and spineless effort and make an appeal for higher standards of mental and physical activity? It does us no good to ascribe our soft, safe and superficial way of doing things to the relaxation that always follows a war. Rather should we profit by the lessons learned in the conflict. The recent war taught us two most valuable lessons—the feebleness and incapacity of over one half of the drafted men for service who had spent little time in exercising for self improvement, and the hardihood and efficiency of the men who were trained by vigorous pursuits for the army. Here again we meet our effective exercitium, the vigorous physical efforts which were first used to train and develop the Roman army which made the term applicable. Again it was *exercitium* that laid the foundation for the training and discipline of the German army. One conquered the world under Caesar, the other held the world at bay for three years under a Prussian Kaiser.

Waiving for the time being the great Christian, moral, ethical or political issues at stake, this fundamental biological principle can not be set aside; we can not get strength, either as individuals or as a nation, without making strong and vigorous efforts. The ability to drive on and guide and direct our efforts toward our own improvement is a God-given faculty that man can not afford to despise. It is only by perfecting our own mechanism that we can hope to maintain a footing in the world and be of any service to others. Here is the philosophy of physical education in a nut shell. The individual gradually acquires those qualities which his special activities require him to put forth. Thus if the activity requires strength, strength will follow with each effort. If it requires skill, skill will come with practice. If it requires alertness, poise, courage, self-command, all these qualities will be further developed as a matter of course.

With these simple fundamental truths in mind, it is interesting to see how Dr. McKenzie has followed the evolution of the general subject of physical education in the United States. Tracing as a physician the physiological effect on the individual of light, heavy and strenuous exercise upon the muscles, heart, lungs and nervous system, he proceeds to analyze the effects of different exercises upon age, sex and occupations.

All exercises are modified in their effects by environments and the supplementary agents of health, air, diet, sleep and clothing—which must be properly regulated and adjusted in order to bring the best results.

He has reviewed the German and the Swedish systems of gymnastics and traced their influence through our American schools and colleges. The influence of English sports and games and the modifying effects of athletics upon our foreign systems of gymnastics develop as we progress through the different chapters. The growth and spread of the general movement for physical improvement of the masses show themselves in the physical program adopted by the Christian Associations, the Boy and Girl Scouts, the Camp Fire Girls and by many other social organizations. Such movements as the growing interest in public baths, the establishment of city playgrounds and the universality of summer camps all testify to the public consciousness of the importance of physical exercise.

Dr. McKenzie has done much to popularize this great movement through the publication of previous editions of this book. The greatest service, however, which he has rendered to the cause of education and to the general public is in calling attention to what physical exercise properly directed will do for the blind, deaf mutes and mental and moral defectives. The interest in physical education has opened a new world to these unfortunate members of the community.

The advent of the great war brought into prominence the value of physical methods in the practice of medicine. No one in the country was better posted than Dr. McKenzie in this branch of therapeutic service, after his extensive study in private and institutional practice. Because of this interest, Dr. McKenzie devoted the last part of his previous book to "Exercise in medicine." It is all the more fitting that the author should devote more attention to this branch of the work in this edition when his previous experience has been supplemented by two years' service as physical training and medical officer in the army during the war and as inspector of physical therapy in convalescent camps and hospitals throughout England, Canada and the United States.

The chapters in this part of the book naturally take up the application of exercise to diseased conditions. Since all parts of the body, including the back, chest, arms, legs, hands and feet function through the use of the muscles and nearly all of the important organs of the body, such as the heart, lungs, stomach, glands, blood vessels and viscera, are dependent upon the contraction of muscles for the proper performance of their functions, the health and tone of the muscular system is a matter of the greatest importance. Not only this set of organs, but even the functions of the brain and nervous system which regulate the rest of the body are dependent upon the condition of the master tissues of the body, the muscles. "This was (to most physicians) for some time a paradox, but now time and experience seem proving it true."

It seems only a natural step from education and developmental gymnastics to medical gymnastics as Hippocrates and Herodotus advocated it.

Dr. McKenzie has shown in this book on exercise how the modified and judicious use of the muscles may be made to restore all parts dependent upon muscular activity to their normal functions. Armed with this knowledge, the physician or his attendant may undertake the treatment of flat feet, weak joints, round backs, drooping heads, uneven shoulders, curved spines, flat chests, abdominal weaknesses and many other bodily weaknesses and imperfections with reasonable hope of complete recovery. Even many diseases of the heart, lungs, stomach and brain may be safely treated through the effect of moderated exercise on the circulatory, respiratory, digestive and central nervous systems.

The author's experience with wounded and diseased men in the war has enabled him to bring the physical treatment right up to date. His ingenuity in devising mechanical appliances to assist the patient in helping himself, and, through his knowledge of applied anatomy, his understanding of the action of the muscles and joints through practice in gymnastics has contributed to make this part of the book unsurpassed as a guide to physicians in physiotherapy.

Perhaps the crowning feature of the book is the apt use of illustrations in both the educational and the medical sections. Here again the author, being a sculptor as well as a physical educator and a physician, has used his artistic eye in selecting the appropriate photographs and the best kinds of models, displaying the proper poses to show the particular action to which he desires to call attention. In fact the work is so meritorious that all people, whether they be physical educators, practicing physicians or intelligent laymen, have reason to thank Dr. McKenzie for taking the time from his absorbing profession to prepare such a book for their benefit. Suffice it to say that every one interested in the general subject should own a copy.

DUDLEY A. SARGENT

FEBRUARY 21, 1923

SPECIAL ARTICLES

NOTE ON THE EQUATIONS FOR TORTUOSITY IN THOMSON AND TAIT'S NATURAL PHILOSOPHY

THE occurrence of two very different expressions for the same thing is always puzzling. It may not, therefore, be superfluous to consider them.

1. If $\alpha, \beta, \gamma, \lambda, \mu, \nu$ are the direction cosines of the radius of curvature R, and of the corresponding normal N to the osculating plane, respectively, the first expression in the well-known classic (section 9, edition 1879), is $t^2 = \lambda'^2 + \mu'^2 + \gamma'^2$, where the dashes denote d/ds and s is the independent variable. This is equivalent to the vector tortuosity, $T = d\,(RN)/ds = i\lambda' + j\,\mu' + k\,\nu'$, and is the obvious increment of the unit normal, RN, per cm. along *s, in full*, and in the direction $RN' + R'N$. But as both N and N′ are vector products each containing r′, this T has no projection on the tangent; and, therefore, for counter-clockwise rotation seen in the direction of the tangent, points in the direction of the radius of curvature.

2. The second expression reads:

$$t^2 = \left(\mu \frac{d\nu}{ds} - \nu \frac{d\mu}{ds} \right) + \text{etc.}$$

and is thus vectorially equivalent to

$T' = R\,N \times d\,(R\,N)\,/\,ds = R^3\,N \times N' + 0;$

and if we insert the vector equations for N and N′

$-T' = R^2\,(r' \times r'') \times (r' \times r''')$

$= r'\,R^3\,(r' \times r''')\,.\,r''$

$= r'\,R^2\,(i\,\lambda' + j\,\mu' + k\,\nu')\,/\,R - NR'/R)\,.\,r''$

$= r'\,T\,.\,R_1 = r'\,(\alpha\,\lambda' + \beta\,\mu' + \gamma\,\nu'),$

the subscript denoting a unit vector. Thus, in value, T′ is again the projection of T on the radius of curvature R. The former (T′) is laid off, however, along the tangent, since T and R are opposed in direction, and is thus a very different thing from T, which is not an immediate tortuosity. The case is analogous to the occurrence of two expressions for the radius of curvature: $(r'')^{-1}$ in the osculating plane and pointing towards the center; and $(r' \times r'')^{-1}$, laid off along the corresponding normal to that plane, inward.

If the normal N had been defined (preferably here, I think) as $r'' \times r'$, rather than as above, the clockwise rotation of the osculating plane seen in the direction of the tangent would correspond to a vector T in the direction of radius of curvature. T′ would at once be positive in the direction of the tangent r′, without compromise; but opposition of sign is none the less inherent in the two projected tortuosities or angles, $d\,R_1/ds\,.\,N_1$ and $d\,N_1/ds\,.\,R_1$.

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VERY SOFT X-RAYS—THE M — SERIES FOR IRON

DURING the past two years several investigators have reported attempts to study the portion of the spectrum lying between the Millikan region and the X-ray region by means of the photoelectric action of the radiation. In every case the curves obtained by plotting the photoelectric current against the accelerating voltage applied to the electrons which generated the radiation showed one or two discontinuities which were interpreted as indicating the excitation of one of the X-ray series in the region under investigation. Now in the ordinary X-ray region the characteristic absorption limits have been found to possess a fine structure which has been interpreted by Kossel as corresponding to the ejection of an electron from one of the inner shells of the atom to the various optical orbits in the outer portion of the atom. If such an explanation is correct then a similar phenomenon should be observed in the soft X-ray region, and therefore we should expect to find not one break in the photoelectric current but several for each X-ray absorption limit. This has been observed by the writer in his research on the soft X-rays, and as the work is still in progress it seems advisable to make a preliminary report at this time.

The apparatus used is in principle the same as that employed by Hughes. The radiation was excited by bombarding a solid target with electrons from a hot tungsten cathode. The radiation fell on a platinum plate producing a photoelectric current which was measured by means of a Compton electrometer using the constant deflection method. Positive ions and electrons were kept from reaching the photoelectric plate by two gauzes, one of which was kept 15-20 volts negative to the negative end of the filament and the other at least 75 volts positive to the anticathode. A third gauze acted as a receiver for the photoelectrons. These gauzes were constructed on metal cylinders so arranged that the only surfaces exposed to the radiation were of metal and at known potentials. The parts of the tube around the photoelectric plate were shielded from the direct action of the radiation. Before making any measurements the tube was baked and evacuated until the pressure under conditions prevailing during experimentation was so low that it would not register on a McLeod gauge which could measure a pressure of 10^{-5} mm. It was found to be impossible to obtain reproducible results at higher pressures.

The curves obtained by plotting the total photoelectric current against the voltage applied to the exciting electrons are similar in appearance to those obtained by Franck and Einsporn for mercury using low voltages. Up to the present time nine distinct breaks have been obtained for iron in the region from 40 to 185 volts. The values for these points are:

Voltage	ν/R	λ
46.8	3.46	264 A
81.7	6.03	151
95.4	7.05	129.6
111.2	8.21	111.0
130.4	9.63	94.6
140.9	10.40	87.8
171.1	10.88	83.9
153.7	11.33	80.5
160.1	11.83	77.0

The wave length, λ, is in Angstrom units, ν is the frequency and R the Rydberg constant.

The first of these points corresponds very well with the value calculated from X-ray data for the transition from the N_5—N_6 level to the M_3—M_4 (the separation between M_3 and M_4 or N_5 and N_6 is too small to be considered in these experiments). This difference can' be obtained from the ν/R values for the $K\beta$ and $K\gamma$ lines as given by Siegbahn. The values are 519.55 and 523.1 respectively, giving 3.55 as the difference which is in good agreement with the value of 3.46 as obtained by the writer. The results have also been successfully checked by using the combination principle to calculate lines in the Millikan region. A more detailed account of this work with additional results will be published in the near future.

Gerhard K. Rollefson
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THE AMERICAN CHEMICAL SOCIETY

(Continued)

Solubility relations among aluminum and antimony salts: E. D. Crittenden. Freezing point curves for pairs of (*a*) aluminum salts and (*b*) antimony salts have been determined by the closed tube method previously employed. With the exception of two compounds in the system, $SbCl_3$-$SbBr_3$, compound formation is entirely lacking in the temperature range investigated. Solubility is limited in several cases and in this regard the almost complete insolubility of AlF_3 in the other aluminum halides may be cited. In the antimony series solubility is more extensive. Several cases of partial miscibility in the solid state have been found. The results indicate that the rules already established by Kendall for binary systems in which the negative radical is constant and the positive varied as widely as possible, apply to the reverse case studied here. By comparing the results in the two series, the marked effect of unsaturation in increasing solubility is clearly indicated.

A reciprocal catalytic pair: A. W. Browne. In catalytic actions where the agent is of the "carrier" type, it should be possible to use interchangeably the filled and the empty carrier, particularly if these are distinct chemical compounds that may be isolated, and if therefore the filling of the carrier is a chemical process. These two forms of the carrier constitute what may be termed a *reciprocal catalytic pair*, that is, a pair of chemical compounds which undergo repeated mutual conversion into each other while exerting their catalytic effect upon a given chemical reaction. Potassium azido-dithiocarbonate, $KSCSN_3$, and azido-carbondisulphide $(SCSN_3)_2$, two new compounds that have been isolated and studied at Cornell, have been found to exert an identical catalytic effect upon the reaction between potassium trinitride andiiodine, which may be expressed by the equations:

(1) $2\ KSCSN_3 + I_2 = 2KI - (SCSN_3)_2$

(2) $2\ KN_3 - (SCSN_3)_2 = -2KSCSN_3\ 2N_3$

(3) $2N_3 = 3N_2$

Physical-chemical studies of creatine and creatinine (I) creatine hydrolysis in acid solution: Graham Edgar and R. A. Wakefield. An experimental study has been made of the rate of conversion of creatine to creatinine in the pressure of hydrochloric acid of various concentrations, and at temperatures between 25°C. and 100°C. The reaction proves to be monomolecular the reaction velocity constants increasing a little more rapidly the acid concentration. The variation of the constants with temperature is expressed exactly by the Arrhenius equation, the "critical increment" being 20,000 cal., a value of the order of that found by Lewis for the hydrolysis of methyl acetate and cane sugar in the presence of hydrochloric acid.

The degrees of hydrolysis of the sodium salts of some organic developing agents: Felix A. Elliott. The degrees of hydrolysis have been determined electrometrically at varying concentrations and temperatures of mono- and di-sodium hydroquinonate, mono-, di- and tri-sodium pyrogallate, mono-sodium p-amino phenol and mono-sodium mono methyl p-amino phenol. The order of magnitude suggests that these agents are classifiable with the pseudo-acids of Hantsch.

The diffusion of helium through quartz at room temperature: Howard M. Elsey. Helium confined under one hundred atmospheres pressure at room temperature will diffuse through a thin walled quartz tube rapidly enough to be detected spectroscopically after a few hours.

Physical chemistry of some volcanic phenomena: George W. Morey. A characteristic of volcanoes is the building up of pressure of volatile components as the magma cools. This is as would be expected of a system containing both volatile and non-volatile components, when the latter crystallize on cooling; and the development of pressure in a crystallizing magma is competent to explain many phases of volcanism. The intermittent action of many volcanoes of the explosive type is explicable on the basis of the rate of release of volatile materials at different levels, together with the heat available from the Joule-Thomson effect at high temperatures.

Plasticity and elasticity: Eugene C. Bingham. Elasticity is usually so defined as to exclude all liquids, no matter how viscous they may be. But many viscous liquids, such as glass, for example, undergo elastic deformation exactly as do true solids below their elastic limit. The term elasticity should be so extended as to include fluids as well as solids or else we must invent a new term. Elastic deformations are not a function of the time as are viscous or plastic deformations, hence it is easy to distinguish between them. In liquids and in solids above their elastic limits the flow tends to obliterate the strain and therefore elastic deformations tend to disappear, but this does not make the elasticity of these bodies any the less real even though it is more difficult to observe and measure. The elastic after-effect is discussed as an example of plastic flow.

Limiting factors determining the concentration of electrolytic potassium amalgam: Clare Martin and James R. Withrow. The authors call attention to, and endeavor to explain the failure of previous workers to obtain concentrated potassium amalgams electrolytically. In a series of experiments with the Shepherd method, they successively eliminate as vital factors (1) exhaustion of the electrolyte, (2) plugging up of the pores of the porous cup, (3) an equilibrium between the rate of formation and decomposition of the amalgam. From a consideration of Kurnakow's curve, they suggest that too low temperature has been the chief limiting factor. Electrolyzing at higher temperatures, they obtain potassium amalgams analyzing 4.69 per cent. potassium. No higher than 2.23 per cent. K. had been previously obtained and Kerp and Bottger state that exceeding 1.6 was accomplished with the greatest difficulty.

The limiting density of phosgene: A. F. O. Germann and Leland R. Smith. The volumetric method used by Morley in his classic researches on the densities of oxygen and hydrogen has been employed in a series of determinations of the density of phosgene. The results parallel those of Germann and Jersey, in that the density of successive fractions of phosgene rises to an approximately constant value, which is, however, below the probable density of the gas. Density measurements were made at pressures of 500 mm., 335 mm. and 170 mm., using a five liter globe. While the absolute numerical value of the results is of little moment, still it is important to note that the limiting density found is approximately four per cent. less than the density at 500 mm., that is, the deviation from Boyle's law amounts to about six per cent. per atmosphere at zero. Our knowledge of the properties of vapors near the point of condensation is very incomplete. Probably no perfectly pure specimen of phosgene has as yet been obtained. The usual methods for the preparation of phosgene yield a product difficult to purify because the impurities are for the most part very soluble in the liquefied gas. It is most important for the progress of the study of the properties of phosgene that a method be developed for the rapid and complete purification of the technical product. Work in this direction in cooperation with the chemical warfare service is in progress at the Stanford Laboratory.

Production of metallic beryllium and its al-

loys: **B. S. HOPKINS AND E. A. ENGLE.** BeO was found to be readily soluble in fused cryolite, but the electrolysis of the solution gave aluminium containing little beryllium. Electrolysis of fused sodium beryllium fluoride yielded considerable metallic beryllium, but it flaked off and was mixed with the oxide, carbide and fluoride. These were separated and flaky beryllium 98 per cent. pure was obtained. Similar electrolyses with metallic cathodes gave alloys containing some beryllium. The chief difficulties in preparing these alloys arise (1) from the tendency of the beryllium to oxidize and (2) from the change in density produced by the introduction of beryllium. Some beryllium-aluminium alloy was produced by preventing the fused metal from rising to the surface.

Preparation and properties of some rare earth metals: **H. C. KREMERS.** With few exceptions the rare earth metals are more electropositive than aluminum, but less so than the alkaline earth metals. Reduction of the anhydrous chlorides with sodium gives only impure metal. Electrolysis of flourides or double flourides results in excessive passivity of the anode due to deposition of fluorine. Those rare earths which are more basic than aluminum can not be electrolized by dissolving the oxide in fused cryolite. Electrolysis of the anhydrous chlorides is most satisfactory. Lanthanum and neodymium have been prepared in quantity and many of their properties studied. Lanthanum being most basic tarnishes very rapidly. Neodymium oxidizes only after several hours exposure to air. Neither lanthanum or neodymium show pyrophoric properties in the ordinary way. Sparks are emitted only when the metals are violently struck. Yttrium metal is being prepared by electrolysis of the fused chlorides. Some of its properties are given.

A tantalide of aluminum: **W. H. CHAPIN.** The tantalide was first prepared by using a modification of the Goldschmit process directly on powdered tantalite. It was found by analysis to correspond to the formula Al_3Ta. Other methods of preparing the compound have been developed. The properties of this tantalide are proving very interesting and important: It is not acted upon by any single acid except H_2F_2; does not oxidize below white heat; reacts with HCl gas at 600°C. We give $AlCl_3 \pm TaCl_5$, releasing the equivalent amount of H_2. Other properties are being studied.

A new halogenoid and halogenoid hydracid: **A. B. HOEL, G. B. L. SMITH AND A. W. BROWNE.** Azido-carbondisulphide $(SCSN_3)_2$, prepared by oxidation of sodium or potassium azido-dithiocarbonate in aqueous solution, is a white, crystalline, explosive solid, very slightly soluble in water, but soluble in various organic liquids, particularly acetone. It undergoes autocatalysis even at ordinary temperatures, yielding a mixture of polymeric thiocyanogen and free sulphur as the final product. It dissolves readily in KOH, yielding at low temperatures potassium azido-dithiocarbonate and potassium oxy-azido-dithiocarbonate, analogous to the chloride and hypochlorite formed when free chlorine dissolves in KOH. From the solution obtained, sulphuric acid reprecipitates the "free" azido-carbon-disulphide. *Azido-dithiocarbonic acid,* $HSCSN_3$, is obtained by treatment of a concentrated solution of sodium or potassium azido-dithiocarbonate with conc. HCl in the cold. It is a white, crystalline solid, soluble in water and in many organic solvents, and is almost as strong an acid as HCl. It decomposes autocatalytically at ordinary temperatures.

A study of adsorption of gases on a surface of mercury: **H. H. KING AND J. LOWE HALL.** Preliminary paper: A new method of measuring the angle of contact between mercury and glass, and the determination of surface tension of mercury. The purpose of this investigation is to study the adsorption of various gases under pressure variation on a surface of mercury through the corresponding changes in surface tension. A new method of measuring the angle of contact and determining the surface tension has been worked out wherein the mercury surface has maximum opportunity to remain undisturbed in equilibrium with the gas at the desired pressure throughout the determination.

Demonstration of a projection electroscope and a projection volt-ammeter: **HOWARD M. ELSEY.** These instruments have been designed to take the place of the slide carrier in a projection lantern. The ease with which experiments in radioactivity and electro-chemistry can be shown to large audiences by the use of these instruments will be demonstrated.

Capillary rise measurements in tubes of various metals a new method of surface tension measurement: **E. K. CARVER.** It was found by Bigelow and Hunter (*Jour. Phys. Chem.*, xv, 367, 1911) that water and benzene rose to different heights in tubes of various metals, and that the height became greater the more electropositive the metal. To verify this an apparatus somewhat similar to theirs was used. A plate of the metal, 1 cm. in diameter, was ground flat and a capillary hole was drilled through it. The diameter of the hole was measured with a micrometer microscope. A glass tube, 1 cm. in diameter, the end of which was ground flat, was placed upright in a battery jar. The metal plate was placed upon the tube after the liquid to be measured had been adjusted exactly to the height of the tube. By siphoning the liquid out of the jar until the liquid broke from the capillary hole in the metal plate, and weighing the liquid withdrawn, the capillary rise could be calculated. In disagreement with Bigelow and Hunter the writers obtained identical results with the different metals. The method is accurate to 0.1 per cent. and is exceedingly rapid.

Studies on the quantitative determination of praseodymium: PAUL H. M. P. BRINTON AND H. ARMIN PAGEL. A study of the much discussed question of the composition of the oxide resulting from the ignition of praseodymium oxalate in air leads to the formula Pr_6O_{11}. This oxide, in absence of other rare earth elements, shows great stability over a wide range of temperatures, and should be used as basis for calculation of analyses. Heating this oxide in vacuo is shown to cause dissociation, with ultimate formation of Pr_2O_3. The disturbing influence of impurities on the composition of this oxide led to the study of a volumetric oxalate method for praseodymium, which is independent of valence changes, and this method is advised for the determination of the element in slightly contaminated material.

The titration of hydrofluoric and hydrofluosilicic acids in the presence of each other: PAUL H. M. P. BRINTON, LANDON A. SARVER AND ARTHUR E. STOPPEL. The differential titration of mixtures of these two acids by sodium hydroxide, first in ice cold solution and then in hot solution, has been studied. Errors from the common method of delivering the samples into platinum weighing vessels from lead tubes have been found, and an improved method of handling the samples has been developed. The effect of silica in standard alkali solutions on the apparent percentages of the two acids has been shown as a source of serious error, and a curve of correction factors for the silica content of alkali solutions, even those which are supposedly pure, has been established.

The use of iodine pentoxide in volumetric gas analysis: C. R. HOOVER AND E. M. BILGER. To replace or supplement the use of cuprous solutions in ordinary gas analysis, it has been found possible to use iodine pentoxide on inert supporting material covered by fuming sulfuric acid. The apparatus employed may be a double absorption pipette for solid and liquid reagent to which a glass stopper has been fitted. The method of manipulation is similar to that employed in the determination of oxygen by means of solid phosphorus. After oxidation in the iodine pentoxide pipette the resulting carbon dioxide is absorbed in a potassium hydroxide pipette. The removal of carbon monoxide by this method is more complete and rapid, and the capacity of the material is greater than is the case with cuprous solutions. In addition, colorimetric indication of the progress of the reaction is provided. Under the proper conditions, removal of carbon monoxide is not interfered with or complicated by the presence of other gases not previously removed during the usual operations of a complete gas analysis.

The determination of iridium in platinum alloys by the method of fusion with lead: RALEIGH GILCHRIST. The method, originally proposed by Deville and Stas, consists of fusion of the platinum alloy with excess of lead, disintegration of the resulting button with nitric acid, followed by treatment with dilute aqua regia to separate the soluble lead-platinum alloy from the insoluble iridium. A critical study of this method was made, using synthetic alloys with iridium content from 0.1 to 20 per cent. Experiments were made to determine the minimum time required for the fusion as well as the optimum temperature, the best proportion of lead, the error due to the solution of iridium by the aqua regia and the effect of the presence of rhodium, palladium ruthenium and iron.

The separation of radium and barium as chromates: L. M. HENDERSON AND F. C. KRACEK. The solubility of the chromates of calcium, strontium and barium decreases with the increasing atomic weights of these elements. Accordingly, radium chromate might be expected to be less soluble than barium chromate. Experiments were carried out to effect a separation of radium from barium by adding definite quantities of potassium chromate to solutions containing both of these elements and at the same time maintaining the volume and acidity of the solutions at such a value that only a small portion of the barium precipitated. It was found that approximately twenty times as much radium was associated with one gram of barium in the precipitate as was associated with a gram of barium in the filtrate. This ratio was practically constant for varying fractions of barium precipitated. Under these conditions the ratio of radium per gram of barium in the precipitate to radium per gram of barium in the original solution varied with the quantity of barium precipitated. It was found that if one fourth of the barium were precipitated, the ratio of radium to barium in the precipitate was 3.5 times that in the original solution.

CHARLES L. PARSONS
Secretary

SCIENCE

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PROBLEMS IN THE FIELD OF ANIMAL NUTRITION[1]

PROGRESS in the profession of animal production is obviously determined by our understanding of the facts and principles upon which it is based.

Having proceeded along lines of least resistance, for a certain time, limits to advancement are reached such that continued progress depends upon the solution of certain commanding or "key" problems. In the service of the profession, and of the nation, the sub-committee on animal nutrition of the National Research Council wishes to call attention to some of these more important problems, with which we are in immediate contact.

In so doing it is our hope that the problems will appeal to research workers in such ways as to result in extensive informal cooperation in their solution, simply through the choice of specific subjects for research within the general field as outlined.

However desirable is close cooperation in research work there may be great practical difficulties in providing for and in accomplishing such a relation. It seems practicable, however, at least to bring about a useful degree of correlation in research by inviting the choice of subjects for study from large projects having importance sufficient to commend them to experimentors and administrators in this field of endeavor.

We would indicate, therefore, the following problems and fields of research as worthy, in our opinion, of extensive and thoroughgoing study:

I. A general program of research on foods of animal origin in relation to human nutrition and to agriculture.

II. Growth curves of farm animals.

III. The establishment of a scientific basis for judging farm animals.

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[1] By the sub-committee on animal nutrition, National Research Council.

IV. The estimation of metabolic nitrogen as a contribution to the perfection of feeding standards.

V. Mineral requirements of farm animals.

VI. Vitamin requirements of farm animals.

VII. Diet and reproduction.

I. A GENERAL PROGRAM OF RESEARCH ON ANIMAL FOODS IN RELATION TO HUMAN NUTRITION AND TO AGRICULTURE

Viewed in the largest and most general way, the human diet must contain a large proportion of cereal foods—for economic reasons.

Cereal products, however, are far from complete foods. Consider, for instance, white flour and refined sugar—perfect foods of their sort, and permanently established in the diet. In themselves they are in no way harmful; in many ways and for many purposes they are unexcelled; but these and other cereal products are among the most deficient of foods in a number of essential nutrients. In fact one of the most important dietary problems confronting civilized man to-day is that of restoring the balance of essential nutrients which has been disturbed by the prevailing use of cereal products.

Since human beings will always consume large amounts of cereal foods, a factor of surpassing importance is that portion of the diet which supplies the essential nutrients in which they (the cereal foods) are deficient.

The classes of foods best qualified to supply these deficiencies are especially the animal foods, meats, milk and eggs, but also fruits, nuts and vegetables.

The costs of production of foods of vegetable origin, in terms of land and labor, may be grouped together, as of similar magnitude.

The costs of production of the highly desirable foods of animal origin are very much greater; so that, in times of economic stress, and as increase of population gradually overtakes the possible food supply, the terms upon which animal foods may be had becomes a matter of very great and of increasing importance.

While all animal foods are relatively expensive they differ much in land and labor costs, and also in nutritive values, dietetic uses and general economic significance, through relation not only to land and labor, but also to transportation, marketing, cropping systems and fertility of the soil.

The objects of this project are (1) to determine the proper place of animal foods, as a group, in the human diet; (2) to establish the facts as to the specific nutritive and dietetic functions of meat, milk and eggs; and (3) to show the position and relationships of the several types of animal food production in the national system of agriculture.

With these points in mind we propose the following outline for an extensive program of researches on food of animal origin.

OUTLINE OF RESEARCH

(1) Human nutrition:

a. The place of animal foods in the diet, in infancy, childhood, maturity, reproduction, senescence, sickness, labor, war and sedentary life; limits of dietetic interchangeability of animal foods.

This group of problems in practical human dietetics has always been, and always will be. We have reached an age, however, in which progress in their solution is possible at rates vastly greater than in any earlier era; and these great problems must be kept constantly before research men in order that no opportunity may be overlooked for contributing to their solution through the undertaking of definite projects of properly limited scope.

The necessary backgrounds for such researches, in the way of laboratories, groups of competent investigators, and institutions of various sorts providing satisfactory groups of experimental subjects, are not uncommon; but men who are able and interested to organize and to conduct such investigations, and who can command the necessary human cooperation, are rare. The more honor then to him who succeeds in this most important field of service.

b. Nutritive values of animal foods as supplementary to other components of mixed diets.

The superiority of animal foods, for supplementary purposes, varies much with the natural food-habit of the kind of animal under observation. It is especially prominent with poultry. It is not so with herbivora. The desirability of experimenting with human beings directly, before drawing final conclusions, is obvious.

c. Nutritive values of constituent compounds, especially the proteins, of foods of animal origin.

The investigation of this group of problems, in the laboratory, with small animals as subjects, will throw much light, by inference, upon problems of human nutrition, and will afford valuable guidance in the planning of experiments with human beings as subjects.

d. Healthfulness of animal foods, as affected by contamination and infection.

More definite information is needed as to the viability of the pathogenic organisms which may be carried by foods of animal origin, as affected by the various methods of preparation and use.

e. Composition of animal foods—amino acids, non-amino nitrogen, fats, phosphatids, inorganic compounds, vitamins; methods of separation and purification of constituent compounds.

Immediate interest would attach to further determinations of the presence of vitamins in various meats and to the iron contents of the same.

(2) Agriculture:

The ever-increasing congestion of population upon the earth renders increasingly important the realization by every man of the nature of his dependence upon agriculture, and of the nature of the complicated agricultural situation upon which he depends.

A series of researches on the subjects here suggested, and the promulgation of the facts derived and assembled, must have a most salutary effect, not only as a stabilizing influence with the man in the street, but particularly through broadening the understanding of some of the leaders among men, who are "educated beyond their information."

This outline is intended to call attention to the fundamental and essential relations of one kind of animal food production to another, and of animal food production, in general, to agriculture.

a. Physiological economy of production of animal foods, considering the entire life of the animal and the entire business of production.

b. Relative draft upon or contribution to soil fertility of various systems of animal food production.

c. Relative proportions of feeds used in various systems of animal food production which are usable by human beings.

d. The utilization of manufactory by-products, farm wastes and unmarketable forage in various systems of animal food production.

e. Systems of animal food production as means of saving cost of transportation of feed.

f. Relative costs of transportation and marketing of various animal foods.

g. Production per acre of land, in various systems of animal food production.

h. Relative labor requirements of various systems of animal food production.

i. Relation of systems of animal food production to cropping systems.

II. THE GROWTH CURVES OF FARM ANIMALS

Throughout our research work in the feeding of animals the results would gain much in value and significance if it were possible to compare them with normal standards.

The development of the vitamin hypothesis, and of the modern doctrine of protein metabolism have been greatly facilitated by the establishment of normal standards, in the shape of growth curves, for the experimental animals used.

Similar normal curves of growth should be determined for all breeds and types of animals of economic value.

These will be of especial service as means of comparison in making graphic representation of the results of studies of breeds, individuality, rations and supplements, in relation to growth, lactation or other performance.

III. THE ESTABLISHMENT OF A SCIENTIFIC BASIS FOR JUDGING FARM ANIMALS

Our present standards of livestock selection rest upon the cumulative experience of many centuries of livestock breeding, the practical judgments of the markets for animal products, and the conventional specifications of the breed associations.

To only a slight extent do these standards rest at present upon results of systematic and orderly studies by the methods of science.

In our opinion the subject of livestock judging is of such practical value and has such appeal to the interest of the student that it can not be spared from the college curriculum; but it is also our opinion that it can not continue indefinitely to hold its own on the present basis.

A scientific foundation should be established for livestock judging, based upon a critical study of the entire subject from the standpoints of the anatomy and physiology of the animal, and also upon the determination of the correlations existing between the measurable proportions and functions of animals, by the methods of biometric research.

The following specific problems for investigation are suggested as illustrating the point of view expressed:

1. A study of factors which influence the apparent spring of ribs.
2. Conditions of the eyes of animals, and what they indicate.
3. Qualities of hair and hide of animals, and what they indicate.
4. Indications of conditions as to texture of flesh of meat animals.
5. Indications of conditions as to density of skeletal structure.
6. The development of heart and lungs as compared with the development of the alimentary tract, in relation to constitutional vigor and to capacity for early maturity.
7. Indications of relative development of muscle, fat and bone.
8. Breadth of chest—what determines it and what it signifies.
9. Relation of heart-girth to development of lungs.
10. Proportions of the skull and what they indicate.
11. Conditions of development of the vertebral column and what they indicate.
12. The anatomy, histology and physiology of the unsoundnesses of horses.
13. Conditions as to development and position of mammary veins and what they signify.

IV. THE ESTIMATION OF METABOLIC NITROGEN

As a temporary expedient, pending the completion of more nearly perfect feeding standards—a very important improvement of the Modified Wolff-Lehmann standards would result from reducing them to a basis of "refined digestible nutrients"—truly digestible crude protein (corrected for metabolic nitrogen) and truly digestible non-nitrogenous nutriment (corrected for fermentation losses in methane and carbon dioxide).

One of the prerequisites of this improvement is the determination of the amount of metabolic nitrogen in the feces. There is no known method for estimating metabolic nitrogen with anything approaching scientific accuracy, but we suggest a method of approach to this problem which seems to us worthy of consideration.

Choose several proteins, which, presumably, are completely digestible. In nitrogen balance experiments add each of these proteins, in graduated amounts, in a series of experimental periods, to otherwise nitrogen-free basal rations. That kind of protein which, when thus varied in amount, does not cause the total feces nitrogen to vary, we would rate as *completely digestible;* and the total feces nitrogen in these periods would be considered as of metabolic origin.

Having thus determined the amount of the metabolic nitrogen, then determine, by further experimentation, the relation of the metabolic nitrogen outgo to the live weight, or to the surface area of the animal, or to whatever other readily determinable factor it may be found to vary with, thus making possible the computation, by difference, of the indigestible and the truly digestible protein.

It is believed that this will give more nearly true figures for metabolic nitrogen than will those representing the total nitrogen of the feces from a nitrogen-free ration, since the presence of a normal proportion of protein in the ration will be conducive to the growth of a normal bacterial flora in the alimentary tract, these bacteria, presumably, contributing an important fraction to the indigestible protein of the feces.

V. MINERAL REQUIREMENTS OF FARM ANIMALS

An important problem in this field is to determine, by carefully controlled, long-time feeding experiments with dairy cattle, under conditions of practice, the effect of differences of intake of mineral nutrients, especially as contained in leguminous as compared with gramineous roughage, and in mineral supplements, on growth and productive efficiency.

In order to obtain reliable determinations of final effects the observations should be carried through the entire period of growth and production, with a considerable number of individuals.

VI. VITAMIN REQUIREMENTS OF FARM ANIMALS

The knowledge of the vitamins should be extended as far as possible into the field of animal production.

Poultry furnish excellent material for vitamin studies; swine are also conveniently usable; and there is some evidence that a vitamin in forage is intimately related to the utilization of mineral nutrients by ruminants.

The effects of feeds, and of methods of production of feeds, on the vitamin content of the milk and the tissues and organs of animals should also be investigated.

VII. DIET AND REPRODUCTION

Evidence is gradually accumulating which suggests that diet is a factor of greater importance than has been understood in relation to reproduction in farm animals. While it appears that mineral nutrients and vitamins may contribute to the specific effects of feeds, in this relation, we do not have evidence to indicate that these effects are due to these two factors alone.

Poultry, swine and cattle are conveniently usable for the investigation of this problem, and there are indications that the general system of farming, as determining the feeds available, contributes in important ways to efficiency of reproduction in livestock. So important a situation must challenge the researcher in the field of animal production.

IN CONCLUSION

The members of this sub-committee, individually, and the sub-committee, as such, have given especial attention to methods of experimentation in animal nutrition. The sub-committee offers its cooperation to any who may desire it, in the making of detailed plans for investigations in any of the fields suggested.

SUB-COMMITTEE ON ANIMAL NUTRITION.
E. B. Forbes, *Chairman.*
State College, Penna.
H. S. Grindley,
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THE CONFIRMATION OF THE EINSTEIN PREDICTION[1]

IN the year 1916 Professor Einstein extended his theory of relativity to include gravitation. Einstein expresses the law of gravitation in a form very different from Newton's inverse square of the distance. But in nearly all applications to the movements of the heavenly bodies the two laws give identical results. Had it not been so, the new theory could not have been right, for Newton's law is able to predict the movements of the sun, moon and planets with the utmost precision. But Einstein pointed out three refined observations in which his law differed from Newton's. The first of these is a small rotation of the orbit of the planet Mercury, discovered by Leverrier and, in spite of many attempts, was not satisfactorily explained. Einstein's law agreed with the observations and accounted for a small divergence from Newton's law. This remarkable achievement aroused the interest of astronomers in the new theory.

Einstein pointed out that not only matter, but also light was subject to gravitation. A ray of light which in its journey to the earth passes near the sun will have its path appreciably bent. If a photograph could be taken showing the stars surrounding the sun, these would be in slightly different relative positions from those they occupy in a photograph taken when the sun is in another part of the sky. Owing to the great light of the sun such a photograph can only be taken during a total solar eclipse. It was pointed out by Einstein that with Newton's law also the light passing near the sun would be deflected, but only to half the extent predicted by the generalized theory of relativity.

Two British expeditions went out in 1919 to observe the eclipse of May, Professor Eddington and Mr. Cottingham to Principe on the West Coast of Africa, and Dr. Crommelin and Mr. Davidson from Greenwich to North Brazil. There were three possibilities. Would the light be deflected at all, or by the amount Einstein's law required, or by half this amount? The observations are not easy, because the quantity to be observed is very small. A star on the photographic plate is a small dot, and the displacements to be expected only amounted to quantities ranging from one third to one tenth of the diameter of one of these small dots. The observers in Brazil had extremely good weather and the expedition was a brilliant success. The observers felt that there was no ambiguity about the result. Einstein's prediction was verified. The observers in Africa were not fortunate in the weather, but obtained photographs showing a few stars, and they confirmed the results found in Brazil.

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[1] From the London *Times.*

An account of the expedition was given to the Royal Society in November, 1919, and copies of some of the photographs taken in Brazil were circulated to representative astronomers. Generally speaking, those astronomers who were used to refined stellar photography agreed that the British astronomers had verified Einstein's prediction beyond any reasonable doubt. A certain number remained unconvinced and it was generally considered that in a matter of such great scientific importance further verification was desirable. Accordingly arrangements were made for the observation of the total solar eclipse of September, 1922. The British expedition to Christmas Island, Mr. Jones and Mr. Melotte from Greenwich, had the disappointing experience of a cloudy day. The American and Australian parties had better fortune. The photographs taken by the Australian astronomers have not yet been measured. The results of the Canadian party were recently received in this country from Professor Chant of Toronto and as far as they go confirm Einstein's law.

The best equipped of the parties was that from the Lick Observatory, consisting of Professor Campbell, Professor Trumpler and a number of other astronomers, who occupied a somewhat inaccessible spot on the northwest coast of Australia. Happily, the enthusiasm, time, labor and money devoted to this expedition have been rewarded. I received a cable message yesterday from Professor Campbell saying that they had completed the comparison of three photographs taken during the eclipse with three which had been previously taken of the same part of the sky. They find for the amount of displacement of a ray of light which would just graze the sun values from 1.86 seconds of arc to 1.59 with a mean value 1.74 seconds, agreeing exactly with Einstein's prediction.

The astronomers of the Lick Observatory are convinced that Einstein's law has been verified sufficiently and propose to devote themselves to other problems at the next eclipse. It is very satisfactory to have a complete agreement on the second of Einstein's crucial tests. It can hardly be doubted that Einstein's law of gravitation is correct, whatever difficulties may be found with other parts of his theory of relativity.

Frank Dyson

Astronomer Royal

The confirmation by President Campbell (for in addition to remaining the Director of the Lick Observatory he is now president of California University, to which the observatory is attached) of the Einstein prediction may be fairly said to settle this important matter. This does not, however, mean that our English observers, who obtained a similar result four years ago, had themselves any lingering doubts, but they knew that in any kind of scientific work it is only too easy to arrive at conflicting results, and when this situation arises the experiments or observations must be continued and varied until the source of conflict is detected and removed, so that all the final results are accordant.

For laboratory experiments such repetition involves little more than industry, for the opportunities are unrestricted; but when the only opportunity for making a test happens to be the rare occasion of a total eclipse of the sun the matter assumes a very different aspect. Each experiment involves a costly expedition to some distant part of the world for which funds may be hard to find; it also may involve discomfort and may end in disappointment. The American observers camped for a month in an unattractive part of the Australian desert, but were fortunate in their weather; our English observers spent six months on Christmas Island, only to have a cloudy day at the last. In addition to such drawbacks it was known that each successive eclipse was, for years to come, a less favorable opportunity for making the Einstein test than the one before.

The best of all was that of 1919, and to the Astronomer Royal belongs the credit of drawing attention to its specially favorable character during the blackest time of the war, when the prospects of utilizing it seemed very remote. Fortunately this dismal outlook did not prevent preparations from being made which enabled the English observers to take full advantage of the opportunity which the Armistice enabled them to grasp, with the well-known result which startled the world.

It was, however, such an amazing surprise that demand for confirmation was in every way reasonable and accordingly parties from Australia, Canada, England, Germany and the United States all prepared to observe the eclipse of last year. There were undoubtedly those who thought the English observers had made a mistake in 1919 and who wished to test the matter for themselves. I think it may not unfairly be said that President Campbell was on the skeptical side, which makes his present testimony the more valuable. Had conflicting results been obtained there would be no alternative but to go on repeating the tests. There is an eclipse this autumn visible in the United States, for which some preparations have already been made, though probably they will now be abandoned. But each successive opportunity, as already stated, offered less than the one before: 1922 was not so good as 1919; 1923 not so good as 1922; others in the future so far as they have been scrutinized less favorable still, so that the announcement of a discrepancy which must be tracked to its source with continually diminishing chances of tracking it would have been a little disheartening.

The telegram to the Astronomer Royal is thus doubly welcome: not only is there natural satisfaction at the accordance of entirely independent testimony on an important matter, but there is also relief from the threat of an arduous campaign, which even confidence in ultimate victory could not altogether compensate. The faces at the meeting of the Royal Astronomical Society yesterday were perceptibly brighter than usual.

H. H. TURNER

UNIVERSITY OBSERVATORY,
OXFORD

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SPRING MEETING OF THE EXECUTIVE COMMITTEE OF THE COUNCIL

THE regular spring meeting of the Executive Committee of the Council of the Association occurred at the Cosmos Club in Washington on April 22. The following members were present: J. McKeen Cattell, H. L. Fairchild, W. J. Humphreys, B. E. Livingston, D. T. MacDougal, Herbert Osborn, Charles D. Walcott, Henry B. Ward. Dr. Simon Flexner and Dr. A. A. Noyes were unable to attend. President Walcott was in the chair during the first part of the meeting, but was obliged to leave before all the business was completed. Dr. H. L. Fairchild took the chair after Doctor Walcott's departure. The following items of business were transacted:

1. The minutes of the last meeting of the Committee and the minutes of proceedings carried out by mail ballots in the interim since the last meeting had been previously circulated to the members and were accepted without being read.

2. The permanent secretary presented his semi-annual report, which will be summarized elsewhere in SCIENCE.

3. The general secretary reported that the committee on Photosynthesis, authorized at the Boston meeting, has been organized with the following members: D. T. MacDougal, chairman; S. E. Sheppard, secretary; W. G. Abbott; F. G. Cottrell; Moses Gomberg; W. J. Humphreys; E. E. Slosson; H. A. Spoehr. This committee hopes to act as a focus for bringing together ideas and suggestions that may lead to substantial progress in our knowledge of photosynthesis and it hopes to serve by facilitating cooperation among research workers in this field. (See SCIENCE for May 4, page 522.)

4. The general secretary reported that he had conferred with the secretary of the Pacific Division with regard to the preparations and plans for the approaching Los Angeles meeting and that the preliminary work for the meeting is progressing very satisfactorily. It was noted that the Los Angeles meeting will be of special interest on account of program features dealing with the solar eclipse that will have oc-

curred just preceding the meeting. Many noted astronomers will be present and will take part in the program.

5. It was voted that, because of the serious illness of Dr. R. S. Woodward, on account of which the executive committee expressed its deep concern, the permanent secretary is authorized to disburse from the funds of his office any payments that would ordinarily be made by the treasurer, it being understood that the permanent secretary's office is to be subsequently reimbursed for such disbursements.

6. The members of the section committee for Section N, nominated by the committee, were elected. The new members of the section committee are as follows: Joseph Leidy, Jr. (retiring at the end of the annual meeting of December, 1926), 1319 Locust Street, Philadelphia, Pennsylvania; R. G. Hoskins (retiring at the end of the annual meeting of December, 1925), 710 N. Park Street, Columbus, Ohio.

7. The executive committee confirmed the election of Dr. Louis T. More, of the University of Cincinnati, as chairman of the local committee for the third Cincinnati meeting and expressed its appreciation of the very satisfactory progress that has already been made by Dr. More and other Cincinnati members in preparing for the next annual meeting.

8. Dr. W. W. Campbell, director of the Lick Observatory and president-elect of the University of California, was nominated to Science Service as one of the trustees of Science Service from the A. A. A. S., to succeed Dr. George T. Moore, whose term has expired.

9. Forty-nine fellows were elected on regular nominations, these being distributed among the sections as follows: B, 2; D, 27; E, 1; F, 5; G, 6; M, 1; N, 3; O, 4. The executive committee instructed the permanent secretary to make arrangements for bringing fellowship elections in the association up to date as soon as may be, if possible before the seventy-fifth anniversary meeting at Cincinnati next December.

10. Dr. Fairchild presented to the Association a photograph taken at the Rochester meeting in August, 1892, and showing portraits of Joseph LeConte (then president of the association), F. W. Putnam (permanent secretary) and H. L. Fairchild (local secretary for the Rochester meeting). This photograph was accepted with thanks by the executive committee and the permanent secretary was instructed to preserve it with the collection of photographs now in his hands.

11. The executive committee considered briefly the relations between the A. A. A. S. and the Union of American Biological Societies and reaffirmed its desire to do everything feasible to further the work of the Union. The appointments of the following representatives of the Association in the council of the Union were confirmed:

Representing A. A. A. S. as a whole:
  Burton E. Livingston;
  Henry B. Ward.
Representing Section F:
  Herbert Osborn.
Representing Section G:
  C. O. Appleman.
Representing Section N:
  C. A. Kofoid.
Representing Section O:
  R. W. Thatcher.

12. It was voted that the committee of bibliography of science be continued. The resignation of the chairman (Dr. C. B. Davenport) was accepted. The executive committee expressed its gratification that the original work of Dr. Davenport and his committee has borne fruit in the present arrangements by which the Concilium Biblographicum is being continued and made still more efficient under the auspices of the National Research Council and the Rockefeller Foundation. Dr. B. E. Livingston was named as chairman of the Committee on Bibliography and the committee was asked to make still further recommendations for the continued improvement of bibliographic and abstracting service in the field of science.

13. The executive committee considered a communication from Dr. C. B. Davenport regarding the plans for the National Union List of Serials, now being undertaken by Mr. H. M. Lydenberg, reference librarian of the New York Public Library, and the H. W. Wilson Company. The committee regards the preparation of such a list as very important and feels that a list of this kind for scientific periodicals is very greatly needed and will greatly facilitate scientific research.

14. The attitude of the American Association with regard to the problem of Pueblo Indian

lands, expressed in principle by action of the council at the fourth Boston meeting, was reaffirmed and a resolution was adopted giving formal statement to that attitude. The resolution will appear in SCIENCE.

15. It was voted that the Association wishes to aid in every feasible way the constructive work of the American Engineering Standards Committee, in its efforts to secure standardization of mathematical and physical symbols and abbreviations. The question as to whether the association should become a formal sponsor for a joint committee on symbols and abbreviations was referred to the association's special committee on this subject, with the request that the last-named committee make recommendations to the executive committee. The special committee consists of the following members: Henry Norris Russell, chairman; Augustus Trowbridge; E. W. Washburn.

16. A report was received on the work accomplished by the special committee on the development of geological features in city parks and the executive committee approved of the plan adopted by the special committee. The committee consists of the following members: W. M. Davis, chairman; E. S. Moore; Charles D. Walcott. A circular letter will soon be sent by the special committee to every American geologist, asking them to further his project to increase the educational value of city parks by bringing geological features to the attention and understanding of the public. For each of a number of cities a prominent geologist will be asked to act as local chairman for this movement, to call a meeting of geologists and other interested persons, which may take the needed steps toward accomplishing the end in view. All members of the Association are asked to lend their aid.

17. The executive committee considered a communication from Dr. C. R. Scholl, president of the Historical Society of Berks County, Pennsylvania, describing plans for the erection of a tablet memorial to Spencer Fullerton Baird, to be erected in Reading, Pa., on the site of his birthplace and voted its hearty approval of these plans.

18. The executive committee approved the action of Section E, as expressed in a memorandum prepared by a special committee of Section E at the recent Boston meeting, urging the establishment of the office of state geologist in Massachusetts, or of a state geological survey.

19. A communication was read from Dr. E. W. Washburn, pointing out the need of financial support for the Annual Tables of data of physics, chemistry and technology, compiled under the auspices of the International Union of Pure and Applied Chemistry, of the International Research Council, and the executive committee instructed the permanent secretary to inquire of the committee on grants whether or not it might be possible to make a grant from the grants funds of the association toward the financial support of the Annual Tables. If such a grant is possible, it might be made with the idea of its being continued in future years. The committee voted that, if the committee on grants is not able this year to take action in support of this project, the permanent secretary is authorized to make from his current funds and for the present year only a contribution of not over $200 for the support of the Annual Tables.

20. Dr. W. J. Humphreys made a progress report for the special committee on science reviews, established at the recent Boston meeting. The report was accepted and the special committee was asked to continue its study of ways and means for inaugurating improved facilities for the preparation and publication of critical reviews of scientific books. The committee consists of the following members: W. J. Humphreys, chairman; J. McKeen Cattell; D. T. MacDougal; Raymond Pearl, Robert B. Sosman.

21. A progress report was accepted from the permanent secretary, regarding the project of securing the organization of the philological sciences in the American Association for the Advancement of Science. Professor W. A. Oldfather, professor of classics in the University of Illinois, has accepted the chairmanship of the special committee on the organization of philological sciences in the A. A. A. S., this committee having been authorized at the recent Boston meeting. Professor Mark H. Liddell, professor of English at Purdue University, is secretary of the special committee. A leaflet signed by seven leading American philologists

has been prepared and will soon be sent out to all who may be interested. A letter signed by the permanent secretary and Professor Liddell *is to accompany the leaflet.*

22. The Potato Association of America was elected to be an associated society of the American Association for the Advancement of Science.

23. The executive committee expressed its gratification with respect to the fact that Retiring President McMurrich will be able to represent the Association at the Liverpool meeting of the British Association for the Advancement of Science. It was recommended that two other representatives be appointed, this matter being left in the hands of the president.

24. The executive committee considered the difficulty encountered in securing good attendance at Council sessions after the first day of the Council meeting (on account of conflicts with section and society sessions). To avoid this difficulty as much as possible the permanent secretary was instructed to inform the members of the Council that the main session of the Council will occur on the afternoon of the first day of the annual meeting, calling attention to the fact that there will be few or no conflicts at that time and also to inform them that Council sessions on the following days will be called promptly at 9:00 and adjourned promptly at 9:45. The permanent secretary was also instructed to arrange for promptness in calling and adjourning the Council sessions.

25. The executive committee voted that it is desirable to hold at least one special joint session at the approaching Cincinnati meeting, to be devoted to the history of the association and of American science during the last seventy-five years. It was suggested that this might well be an evening session with a lecture on this subject to be given by some prominent man of science. Further details in this regard were left in the hands of a special committee, with power, consisting of J. McKeen Cattell, chairman, L. O. Howard, B. E. Livingston.

26. The executive committee expressed its gratification at the arrangement of the Society of Sigma Xi, by which Dr. W. R. Whitney, of the General Electric Company, is to give the second annual Sigma Xi lecture, under the joint auspices of the Society of Sigma Xi and the A. A. A. S., at the third Cincinnati meeting. This lecture is to be given on the evening of the *second day of the meeting, Friday, December* 28, 1923.

27. The possibility of securing more extended publicity for the annual meeting by the use of a gummed label or poster, by special printing on the envelopes used in correspondence during the autumn, or by other means, was considered briefly and the permanent secretary was instructed to study this matter and proceed according to his judgment. The permanent secretary will be glad to receive suggestions from the members in this connection.

28. On account of financial and other conditions in the South and with the approval of Dr. A. P. Bourland, secretary of the Southern Education Society, it was voted that affiliation of the Southern Education Society be discontinued.

29. The request from the treasurer of the Ohio Academy of Science that the Washington office collect all academy dues of academy members who are members of the American Association for the Advancement of Science was considered and the permanent secretary was instructed to carry out this suggestion for the Ohio Academy and also for the North Carolina Academy, for one year, and to report as to its feasibility.

Burton E. Livingston
Permanent Secretary

SCIENTIFIC EVENTS

THE BRITISH METEOROLOGICAL OFFICE[1]

The annual report of the Meteorological Committee to the Air Council for the year ended March 31, 1922, has recently been issued. It is the sixty-seventh year of the Meteorological Office and the second report submitted to the Air Council instead of to the Treasury as formerly. The meteorological service now comprises many meteorological organizations which in past years have been carried on separately and independently. In all, the total staff aimed at to complete the organization is 375. Retrenchments undertaken, however, by all government departments have led to some modified programs for the meteorological service and reductions in the staff have taken place instead of the wished-for augmentation. The total whole-time staff of the Meteorological Office and its out-stations has changed during the year from 266 to 261. The year has seen a great increase in the interest of seamen in weather information and the report mentions that it is greatly to be regretted that this increased interest should coincide with conditions which have made it imperative to reduce rather than to extend the activities of the Marine Division. Data now being received are gradually getting back to pre-war conditions, when it was equally felt that excessive observations were costly. For forecasting work the report states that, although certain messages are still received by cable, almost all European countries have now adopted the use of wireless telegraphy and it is growing evident that it will shortly be possible to dispense with exchange of messages by cable. Much information is given relative to aviation and the upper air, new developments entailing much organization. The British Rainfall Organization is now controlled by the Meteorological Office and among many other branches of work may be mentioned atmospheric pollution and the oversight of attached and subsidiary observatories.

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[1] From *Nature.*

THE "ZOOLOGICAL RECORD"

MR. P. CHALMERS MITCHELL, of the Zoological Society of London, writes to the London *Times* under date of April 21, as follows:

May I say that the council of the Zoological Society will much regret if the *Zoological Record*, which it has supported with increasing financial difficulty for many years, has to be dropped? But the annual loss on the issues is over £1,100, and is likely to increase as the output of zoological research increases.

Bibliographical work, although necessary for all branches of zoology, is of less immediate concern to a society whose primary function is the care and study of living animals than to museums, general laboratories, universities and the various institutions dealing with medical zoology, parasitology, economic entomology and so forth. Last year the council, in its annual report and in circulars addressed to zoologists and zoological institutions throughout the world, explained the financial position, and stated that unless those to whom the *Record* was "invaluable" showed their appreciation of it by subscribing for a sufficient number of copies, the society could no longer undertake the publication. The response was unsatisfactory, and the council has accordingly taken the inevitable step of making it known that the *Record* will be discontinued unless substantial help is forthcoming. But it is so anxious to give those to whom the *Record* is necessary full opportunity of coming to its support, that it has undertaken to proceed with the compilation so that no time may be lost.

I fear that the suggestion of your correspondent, Mr. Stanley Kemp, in to-day's issue is not helpful; because of the drain of the *Record* on our resources we have already been compelled to suspend the publication of our "Transactions," and to postpone other scientific work of immediate interest to us; we are certainly not going to suspend the issue of our "Scientific Proceedings," which have appeared continuously since 1829, in order to carry out bibliographical work for other institutions. On the other hand, we are ready to continue the *Record*, and to regard a loss of £500 a year as part of our contribution to the common good of zoological science, if other institutions guarantee us against further loss.

A NEW CHEMICAL LABORATORY FOR HARVARD UNIVERSITY

IMMEDIATE measures for raising funds for a new chemical laboratory at Harvard University are imperative, according to the report of a committee of graduates appointed by Langdon P. Marvin, '98, president of the Associated Harvard Clubs, to consider the needs of the department of chemistry.

Stating emphatically that the present physical dilapidation of Boylston Hall, the main Harvard chemical laboratory, is "almost beyond belief" and that thirty-three years ago it was already considered antiquated, the committee asserts that even if this building is extensively repaired, "the only result achieved will be a third-class laboratory that has accommodations for about one-half the number of students that will be forced to work in it. It would be utterly impossible to provide for normal growth by such means."

Every graduate who has a son going to Harvard should visit Boylston Hall and see where he will have to work [reports the committee]. What can be said for the professors who have to do the teaching? Simply that devotion to the university and their belief in its future has kept them at their posts. Every one of them could step out into better positions. In theoretical chemistry the Harvard staff have no superiors in America to-day. It is manifestly difficult, however, to hold a faculty together when such sacrifices are demanded, and new professors from the outside are not attracted to Harvard, which is not a healthy condition for any faculty to be in. How long then must chemistry at Harvard be confined to the narrow, unsuitable, inadequate bounds that restrict and distort its growth?

The present inadequate provision for the study of chemistry is not a matter that concerns only the Division of Chemistry when so large a proportion as thirty-five to forty-five per cent. of the undergraduates is involved. The necessity of the occasion demands that every Harvard man and every friend of Harvard should at once become interested in this most vital need of the university. When the Associated Harvard Clubs and the alumni of Harvard really understand this deplorable and impossible condition of the Division of Chemistry, this committee believes that they will not rest until the situation is cured.

The committee of Harvard graduates which made the report is headed by Edward Mallinckrodt, Jr., of Saint Louis. The other members are Dr. William S. Thayer, of Baltimore; Professor Theodore W. Richards, of Cambridge; W. Cameron Forbes, of Westwood, Mass.; Martin H. Ittner, of Jersey City; Eugene DuPont, of Greenville, Del.; Eliot Wadsworth, of Washington; G. Cook Kimball, of Pittsburgh; Isaac P. Hazard, of Syracuse, and Elihu Thomson, of Swampscott, Mass.

CONFERENCE ON WEIGHTS AND MEASURES

The sixteenth annual conference on weights and measures will be held at the Bureau of Standards on May 21 to 24 inclusive. Invitations have been sent out to all state, municipal and other officials who are interested in weights and measures matters and judging by the replies received the conference will be unusually well attended.

A tentative list of papers which will be presented has been prepared, the titles of some of which are as follows: "Fraudulent practices and how we eliminated them," "The attitude of the Mid-west toward abolition of bushel weights," "Temperature as a factor in the measurement of gasoline," "Cooperation between state and local officials," "Divergence in bread labeling requirements," "Bread weight regulation from the standpoint of the retail baker," "The organization and conduct of city and county departments of weights and measures," "Problems arising in the supervision of public markets," "Origin and destination weighing of coal in carload lots," "Retail sales of coal and coke," "A standard test method for milk bottles," "Results of the Bureau's investigation of the commercial filling of milk bottles," "Commodity tolerances" and "Sale of service by weight or measure."

Among the reports of committees will be one on bread legislation and another on specifications and tolerances for vehicle tanks and fabric measuring machines.

The first morning of the conference will be devoted to the reports of delegates, while the second day will be "City and County Day," its sessions being devoted entirely to the problems of city and county weights and measures officials.

In connection with the conference the usual exhibit of weighing and measuring appliances will be held in the Industrial Building of the Bureau and it is expected that a large number of firms will avail themselves of this opportunity to set before weights and measures officials the latest improvements in their products.

THE FIRST DECADE OF THE ROCKEFELLER FOUNDATION

The Rockefeller Foundation was chartered by special act of the New York State Legislature on May 14, 1913. The following statement of contributions and programs during this first decade is made by Edwin R. Embree, the secretary.

While the chartered purpose is broadly stated as "the well-being of mankind throughout the world," the work of the Foundation has become chiefly centered upon public health and medical education.

The expenditures during the first decade, 1913 through 1922, have amounted to seventy-six and three quarters millions ($76,757,040), roughly divided as follows:

Public health	$18,188,838
Medical education	24,716,859
War relief	22,298,541
All other philanthropic work	10,445,628
Administration	1,107,174

In carrying on its various activities the Foundation has expended all of its income from year to year and in addition seventeen and a half millions ($17,500,000) of its general fund or principal. A further sum of fifteen and a half millions ($15,500,000), payable in future years, has been pledged to various medical schools and public health projects.

Contributions outside the field of public health and medical education were made, for the most part, during the war and in the earlier years of the foundation's work before its policies and program had become clearly defined. The chief item in this group is the sum of five and two thirds millions ($5,678,599) given to various charities designated by the founder before he relinquished on July 19, 1917, the right he had originally reserved personally to direct the use of a part of the income. A million dollars was given to Herbert Hoover's child-feeding plan in Europe, and another to make possible the Palisades Interstate Park.

In the development of the foundation's program there has been increasing concentration upon medical education and public health.

The International Health Board, established as a department of the foundation in 1913, has sought to promote public health throughout the world by demonstrating the methods and costs of controlling certain diseases, notably hookworm disease, malaria and yellow fever; by fostering the growth of governmental health agencies; and by encouraging the formation of schools of hygiene. In carrying out this program the board has cooperated with twenty-seven American states and fifty foreign governments. Its annual expenditures have increased from $133,237 in 1914 to $1,842,249 in 1922.

In medical education a special feature has been the work of the China Medical Board, in building, equipping and maintaining a modern medical center in Peking. The board has made appropriations to other medical schools and to thirty-two hospitals, as well as to the fostering of science education in China.

Substantial contributions have been made in recent years to centers of medical teaching in London and Brussels. The foundation has also cooperated in the development of medical education in North and South America, Western and Central Europe, the Philippines, Hong Kong and Bangkok.

FELLOWSHIPS IN BIOLOGY OF THE NATIONAL RESEARCH COUNCIL

AT the meeting of the Board of National Research Fellowships in the Biological Sciences, held on April 25, 1923, the following appointments were made: E. G. Anderson, botany; L. R. Cleveland, zoology; R. T. Hance, zoology; M. J. Herskovits, anthropology; Leigh Hoadley, zoology; Marian Irwin, botany; Donald A. Laird, psychology; A. J. Riker, botany; Leslie Spier, anthropology.

On account of the short time available for receiving applications, it was decided to hold another meeting of the board toward the end of June for the consideration of deferred applications in hand and also of other applications that may be received prior to June 1st. Requests for information and application forms should be addressed to the Secretary, Board of National Research Fellowships in the Biological Sciences, 1,701 Massachusetts Avenue, Washington, District of Columbia.

SCIENTIFIC NOTES AND NEWS

THE Walker grand prize of $1,000 has been awarded by the Boston Society of Natural History to Dr. Leonhard Stejneger, head curator of biology at the United States National Museum at Washington, District of Columbia. The Walker annual prize of $60 has been awarded to William Seifriz of Yale University for an essay on "Colloidal properties of protoplasm."

THE gold medal of the Mining and Metallurgical Society of America for 1922, awarded to Robert Peele, professor of mining at Columbia, was formally presented to him on April 26 at a dinner held at the Aldine Club, New York City. The medal is given annually by the society "for distinguished service in the literature of mining."

AT its meeting in Baltimore on April 25 Professor E. V. McCollum, of the School of Hygiene and Public Health of the Johns Hopkins University, gave an address before the Tri-State Medical Association on "The influence of diet on bone and tooth development." In recognition of Professor McCollum's researches in this field the association presented him its Stephen A. Trimble medal.

At the recent celebration of the fiftieth anniversary of the establishment at the State University of Iowa of the first department of education, the honorary degree of doctor of laws was conferred on Dr. Edward Lee Thorndike, professor of education and director of the Institute for Educational Research at Teachers College, Columbia University; on Dr. Charles Hubbard Judd, professor of education and dean of the School of Education of the University of Chicago; on Dr. Ellwood P. Cubberley, professor of education and dean of the School of Education at Stanford University, and on Professor James E. Russell, dean of Teachers College, Columbia University.

The Anthropological-Geographical Society of Stockholm has conferred the Anders Retzius medal in gold upon Sir Aurel Stein for his archeological research in Central Asia.

Professor J. Proudman, director of the Liverpool University Tidal Institute, has been awarded the Adams Prize of the University of Cambridge for an essay on "The theory of the tides." The essay submitted by Dr. H. Jeffreys has been highly commended by the examiners.

At the annual meeting of the British Iron and Steel Institute on May 10, the Bessemer medal was presented to Dr. W. H. Maw.

Professor Nuttall and Professor Sir W. J. Pope are to be appointed to represent the University of Cambridge at the ceremonies connected with the centenary of the birth of Pasteur, which will be held in Paris and Strasbourg next month.

Dr. Louis O. Kunkel, pathologist of the experiment station of the Sugar Planters' Association of Honolulu, Hawaii, has been appointed head of the work in plant pathology of the Thompson Institute for Plant Research at Yonkers, New York. Dr. Kunkel, with a protozoologist and several others representing various sorts of biological technic, will devote his time to the study of "aster yellows" and other mosaic types of disease.

Dr. Bert W. Caldwell has been appointed superintendent of the university hospital at the University of Iowa by the State Board of Education to succeed Dr. Arthur J. Lomas, who has gone to a post at the University of Maryland. Dr. Caldwell comes from Vera Cruz, Mexico, where he was a member of the yellow fever commission.

Sir Henry M. W. Gray, of the Aberdeen Royal Infirmary, has accepted the appointment of chief of the surgical staff of the Royal Victoria Hospital, Montreal.

Dr. P. A. Maplestone, who is a graduate of the University of Melbourne and has until recently been lecturer of protozoology in the Liverpool School of Tropical Medicine, has been appointed assistant director of the Research Laboratory at Sierra Leone.

F. W. Willard has been appointed superintendent in charge of chemical engineering, development and research for the general manufacturing department of the Western Electric Company's Hawthorne Works, Chicago, Illinois.

The division of chemistry and chemical technology of the National Research Council, Washington, D. C., has named James R. Withrow, of the Ohio State University, as chairman of the National Research Council Committee on the use of sodium compounds as a substitute for potassium compounds, both in scientific and industrial work.

Appointment of four members of the committee to conduct an investigation of the storage of coal is announced by the Federated American Engineering Societies. They are: P. F. Walker, dean of engineering, University of Kansas; S. W. Parr, professor of applied chemistry, University of Illinois; H. Foster Bain, director of the United States Bureau of Mines; L. E. Young, Union Light and Power Company, St. Louis. The chairman is W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, Chicago. Four or five additional members of this committee are yet to be selected. Consideration is being given to recommendations by member organizations and it is probable that the committee will be completed in the near future.

The British secretary for mines has appointed the following to be additional members of the Safety in Mines Research Board: Professor W.

S. Boulton, Professor S. M. Dixon, Dr. J. S. Haldane, Professor C. H. Lees and Professor J. F. Thorpe.

At a meeting of the permanent committee of the International Society of the History of Medicine, held at Antwerp on April 11, 1923, it was voted to hold the Fourth International Congress of the History of Medicine at Geneva, Switzerland, during the third week of July, 1925. The following officers were elected: *President:* Dr. Charles Green Cumston, Geneva. *Secretary General:* Dr. A. de Peyer, Rue General Dufour, 20, Geneva. *President of honor:* Sir D'arcy Power, London. *Vice-presidents of honor:* Dr. Edward B. Krumbhaar, Philadelphia; Dr. J. G. de Lint, Gorinchem, Holland; Dr. Tricot Royer, Antwerp; Dr. Charles Singer, London; the president of the Medical Society of Geneva for the year 1925.

T. Gilbert Pearson, president of the National Association of Audubon Societies, sailed for France on May 12. He is going in the interests of furthering the organization and work of the International Committee for Bird Protection, of which he is founder. The committee is composed of representatives elected by leading scientific and conservation organizations in the United States, Canada, Australia, Norway, England, Holland, Luxemburg and France. He goes to Europe as representative of the National Association of Audubon Societies and the American Ornithologists' Union to address the International Convention shortly to be held in Paris under the management of the Societé de Nationale d'Acclimatacion de France.

R. P. Rose, chemical engineer of the United States Rubber Company, has returned to this country after having spent two years in Sumatra, where he installed plants for the utilization of the Hopkinson process for producing rubber and equipment for the shipment of latex.

Dr. M. Luckiesh, director of the Nela Laboratory of Applied Science of the General Electric Company of Cleveland, delivered an address at Toronto before the Royal Canadian Institute on the subject "Artificial light and civilization" on April 21.

Professor Bakule, of Prague, Czecho-Slovakia, gave a lecture and demonstration under the auspices of the St. Louis School of Occupational Therapy at Washington University School of Medicine on May 1. He is touring the United States with a group of handicapped children, whom he has trained to become adept at some gainful occupation. Many of the children would ordinarily be considered as hopelessly incapacitated for life, but instead of being private or public charges, they are able to contribute not only to their own maintenance but to others as well. Briefly stated, his methods are based on appeals to curiosity and direction of their activity along the desired lines.

Professor Emmanuel de Margerie, director of the Geological Map Service of Alsace and Lorraine, gave a series of six illustrated lectures on geology at Yale University, beginning on May 7 and continuing through May 15. Professor de Margerie is visiting the United States under a plan perfected by the committee of American Universities on exchange with France of professors of applied science and engineering, with assistance of the Institute of International Education. This committee represents seven institutions: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, University of Pennsylvania and Yale. The topics of these lectures by Professor de Margerie are: "The topographic map of France," "Brief history of the geology of France," "Structural work in the Paris basin, Northern France and Belgium," "The Jura Mountains," "The Western Alps in France and Switzerland," "Provence," "The Pyrenees," "The Western Mediterranean basin."

The twenty-ninth James Forrest lecture of the Institution of Civil Engineers, London, was delivered on May 4 by Sir Richard Glazebrook, who took as his subject "The interdependence of abstract science and engineering."

The Adolph von Baeyer Memorial lecture was delivered before the Chemical Society, London, by Professor W. H. Perkins, on May 10.

Mr. F. W. Harmer, for more than fifty years a fellow of the Geological Society and well known for his studies of pliocene mollusca, died on April 24, aged eighty-seven.

THE death is announced of Dr. V. Th. Homén, professor of applied physics in the University of Helsingfors, aged seventy-five years.

A MESSAGE received at the Harvard College Observatory from the Rev. Joel H. Metcalf of Portland, Maine, announces the discovery of a comet by him on May 7 in the constellation Ophiuchus, near the star Alpha Opiuchi. The comet was of the ninth magnitude, much too faint to be seen without a telescope, and was moving slowly. It appeared round and brighter on the southwest side. Another telegram received at the observatory from the Lowell Observatory, Flagstaff, Arizona, announces the discovery of a new star by Lampland on May 5 in the great spiral nebula Messier 83. The nova was roughly of fourteenth magnitude, which indicates that it would be visible only with a powerful telescope.

THE discovery announced last year by workers in the Toronto University that an extract from the pancreas of animals is a palliative of diabetes, and the later discoveries that the active substance, called "insulin," can be prepared from the pancreas of fishes, have suggested that the development of this possibility might be of considerable importance in the fisheries of this country. Accordingly, The Fisheries Bulletin reports that arrangements have been made by the Bureau of Fisheries and the hygienic laboratory of the Public Health Service to cooperate in an investigation of the possible production of insulin from fishes. The Bureau of Fisheries is to do the field work in studying the sources and collecting the material, while the hygienic laboratory is to do the laboratory and experimental work, including preparation and standardization of the pancreas extract. A. A. Ellsworth, who is doing the field collecting, went to Fernandina, Florida, in April, where he is now collecting pancreas from sharks at a shark fishery. About 36 sharks a day are being taken. The pancreatic glands of each shark weigh 200 grams or more (around one half pound). It may be noted that the viscera of fish when used at all are used for producing fertilizer and oil, low-priced products. This is the first effort to produce high-priced biological products for medicinal purposes from the glands of fishes. Fish, of course, contain the numerous glandular substances that are found in other animals.

THE British Colonial Office, as reported in the London *Times*, makes the following announcement respecting the *Discovery's* new voyage: The secretary of state for the colonies has appointed an executive committee to control the researches recommended by the Inter-Departmental Committee on Research and Development in the Dependencies of the Falkland Islands, and in particular the investigation of the question of the preservation of whales and of the whaling industry, which has been subject to government regulation since its inception nearly twenty years ago. The members of the committee are as follows: Mr. Rowland Darnley (chairman), Colonial Office; Sir S. F. Harmer (vice chairman) British Museum, Natural History Department; Mr. H. T. Allen (financial member), Colonial Office; Mr. J. O. Borley, Ministry of Agriculture and Fisheries; Captain Robert W. Glennie, R.N., Admiralty; Mr. J. M. Wordie, Royal Geographical Society; and Sir Fortescue Flannery, of Messrs. Flannery, Baggallay and Johnson, consulting naval architects to the Crown Agents for the Colonies, who has consented to serve as a member of the committee until the *Discovery*, which has been purchased for the purposes of the research expedition, has been reconditioned. The *Discovery* is Captain R. F. Scott's old ship, in which also Sir Ernest Shackleton served. She will be principally employed in the waters of South Georgia and the South Shetlands. It is not anticipated that she will be ready to start before next year.

As headquarters for a geological field station ten acres of land in Ste. Genevieve County, Missouri, were given to the University of Chicago in 1921 by one of its graduates, Mr. William E. Wrather, a geologist of Dallas, Texas. At the same time the donor provided a concrete building for kitchen and dining room purposes and a concrete springhouse to protect the water supply. Through the generosity of the donor also two new buildings are now being erected, one for dormitory purposes, to accommodate twenty students, and another to provide facilities for shower baths. Field instruction in geology has been conducted by the university in Ste. Genevieve County each season since 1914, except during the two war years, 1917-18.

The establishment of the permanent camp has made possible much more efficient class work. The region available for study exhibits a remarkable variety of geological phenomena in a small area. The whole district studied is about five or six miles long and less than three miles wide, and the permanent camp is situated near the center. Within this area more than twenty-five distinct geological formations are outcropping, ranging in age from the Cambrian to the Mississippian, most of them being more or less abundantly fossiliferous. In addition, unusual fault phenomena provide problems of great interest for class work, while there is a remarkable opportunity for the collection of fossils from numerous Paleozoic horizons. It is proposed in the near future to expand the work at the Field Station into a real Field School of Geology and to continue it throughout the summer quarter, with a number of distinct courses and the proper instructors for each.

EMPLOYING the methods of engineering, research in eye conservation on a nationwide scale has been undertaken by the Eyesight Conservation Council of America. The work is in charge of J. E. Hannum, a former member of the teaching staff of Purdue University and a member of the American Society of Mechanical Engineers. The plan, which follows revelations of human and industrial waste in industry, made by the Hoover Committee on the elimination of waste in industry of the Federated American Engineering Societies, of which J. Parke Channing of New York is chairman, aims to determine the extent to which attention is being given to the conservation of vision in the educational, commercial and industrial activities of the United States. A study of statutory provisions now in force and affecting eyesight will be carried on. Experiments to determine the true economic value of perfect vision will be made. It is proposed to measure the improvement in health, increase in quality and quantity of production, advancement of individual performance and decrease in losses due to waste and accident. Factory, home and school lighting, now a subject of scientific research here and abroad, will be studied. Mr. Hannum, a former Indianapolis engineer, is a graduate of Pennsylvania State College, and was formerly connected with the Red Cross Institute for the Blind in Baltimore.

UNIVERSITY AND EDUCATIONAL NOTES

THE committee of the Associated Harvard Clubs which is raising $250,000 to endow five professorships at Berea College, Kentucky, in memory of Professor N. S. Shaler, the Harvard geologist, has been continued for another year to go on with its campaign, which has already secured more than $50,000.

WINTHROP MORE DANIELS, a member of the Interstate Commerce Commission, has been appointed to the newly established chair of transportation at Yale University.

DR. B. B. BRACKETT, who has for the past fourteen years been the head of the electrical engineering department at the South Dakota State College, has accepted a professorship of electrical engineering in the college of engineering of the University of South Dakota.

DR. H. M. DADOURIAN, associate professor of physics at Trinity College, Hartford, Connecticut, has been appointed Seabury professor of mathematics.

DR. R. W. WHYTLAW-GRAY, science master at Eton College, has been appointed professor of chemistry at University College, London, in succession to Professor Arthur Smithells.

We learn from *Nature* that Dr. S. P. Smith, assistant professor in the City Guilds (Engineering) College, Imperial College of Science and Technology, London, has been appointed professor of electrical engineering at the Royal Technical College, Glasgow, in succession to Professor Magnus Maclean, who is about to retire after occupying the chair for twenty-four years.

DISCUSSION AND CORRESPONDENCE

AS TO THE CAUSES OF EVOLUTION

ABOUT a year ago I published a note (SCIENCE, April 14, 1922) on the evolution controversy. In this I spoke of the causes of evolution. It has come to my attention that my remarks on this subject have been considerably misunderstood. And it now appears that one of these misunderstandings is likely to be used in a way I should not like. Consequently, another note seems to be in order, this one dealing with the subject not incidentally as the other did, but directly.

A cardinal element in my theory of causality as applied to evolution is indicated by the fact that I always speak of the *causes* and never the *cause* of evolution. A multiplicity of causes is the point. Probably few biologists now fail to recognize that more than one cause has always been and still is operative in producing the living world. Nevertheless, it strikes me that few there are who accept the principle of cooperating causes, not in organic production merely, but in all natural processes, as wholeheartedly as by right it should be accepted.

While many evolutionists show a sort of grudging assent to the idea by speaking of "causal factors" or just "factors," they appear to harbor the notion that after all there must be one King Cause, as we may say. This, some stoutly maintain, or did until recently, has been discovered. Instances: Some of the polemics in favor of natural selection, or mutation, or the inheritance of acquired characters. But such discussions are becoming less frequent than they were and this is a real gain.

Such a state of mind on the subject is, I strongly suspect, a hold-over of the old theological idea of one Great Primal Cause. The later doctrine of "first" causes and "second" causes appears to have been a compromise forced upon the original idea by progress in natural science.

As concerns the origin of species, I wonder if the causal difficulties, great though they unquestionably are, have not been magnified by a mere verbal accident, as it may be called. Has not the substitution of the word evolution for that of development been a great misfortune in this matter? It seems to me so.

I do not believe there is a thing in the phenomena of origination in living nature that justifies any distinction between the two words as applied to those phenomena. Dictionary definitions certainly warrant this view. But much more convincing is the fact that neither Lamarck nor Darwin, the two major prophets of modern transformism, hardly used the term evolution at all, though both made much use of development. In later practice, however, a very sharp distinction between the words has undoubtedly grown up. And one result of this seems to have been to make us hope and strive for causal explanation when we use the term evolution in a sense in which we do not any longer when we use the term development. So marvelous is the beguiling power of words!

Do working horticulturalists, stock-raisers or embryologists nowadays think of such a thing as some one cause or even of just a few completely discoverable causes of development of the individual plants and animals and embryos with which they work? Certainly not. And, it should be noticed, the case is not different when they think of the varieties and races with which they work.

Unquestionably the problem of what causes that crucial step in the origin of species which makes them sexually incompatible with all other species is one on which we have little light as yet.

But how justify, either by fact or logic, the widely prevalent seeming assumption that whatever causes this particular step is the cause of the origin of species and hence of organic evolution, par excellence?

Certain is it that the races, varieties, subspecies, etc., with which we are familiar are naturally caused somehow. And if these may become true species, as Darwin believed and most naturalists believe, by what hocus pocus of reasoning can we exclude variety-producing causes from being also species-producing causes, the moment the varieties become species? Reasoning of this kind would require us to say that the causes which produce the sapling can not be included among those which produce the tree.

What I am standing for is the factual truth, and the scientific importance of the principle of many cooperating causes in organic development. Whether the development be of individuals, of varieties, in nature or under cultivation, of subspecies, of full-fledged species, of genera, or what not, matters not at all.

And I would insist that if in formal biology the principle could be viewed and discussed in this common sense way much of the futile or worse controversy within the biological realm, and the bewilderment among intelligent people outside of that realm, would disappear. For it would be recognized on all hands that very much is known about the causes of all development even though certain steps, notably that by which species become differentiated sexually from other species, are still very obscure as to causation. No sane person could then make the charge, now being made by persons who undoubtedly are sane, that biologists "know absolutely nothing at all about the cause of evolution." Nor would even a fundamentalist Bishop be likely to announce himself (as one has recently been reported to have done) as standing four square against evolution, if evolution and development were everywhere recognized as being one and the same thing.

And the gain to clear thinking in biology itself would also be great in that the idea, often as vehemently defended as it is vaguely held, would vanish, that certain supposed causes of evolution must necessarily exclude one another.

What real justification is there, to illustrate, for assuming that if natural selection is a true cause of evolution, the inheritance of acquired characters must be denied—or vice versa? Darwin's position on this was beyond question logically sound. For him there was no *a priori* exclusiveness as between the two. It was solely a matter of evidence—of objective evidence. And so in the nature of the case is it to-day and so it will remain. Does anybody really believe that should one or more of the strong indications recently brought to light of the heritability of somatic modification be fully proved, natural selection would thereby be disproved?

It will be a great day for science when she shall have gained such a mastery over her mental technique that while speculative thinking shall continue to supplement and extend common sense thinking, it shall no longer destroy it.

WILLIAM E. RITTER
THE SCRIPPS BIOLOGICAL INSTITUTE,
LA JOLLA, CALIFORNIA

MARINE PLEISTOCENE FOSSILS FROM NEW YORK CITY

RECENTLY a fossil bivalve was sent by Stanley N. Shaw, editor-in-chief of the *Federal Reserve Club Magazine*, of New York City, to the geology department of Cornell University for the determination of its character and history.

The shell was uncovered on September 30, 1922, by the workmen in excavating for the foundation of the new Federal Reserve Bank which occupies the block between Nassau, Liberty, William Streets and Maiden Lane; the specimen excited the interest of the officials and consequently was sent to Cornell. Three other shells and a piece of wood were also discovered at the same locality and later sent. These fossils prove to be of Pleistocene age and belong to the following species:

Venus mercenaria Linnæus cf. *antiqua* Verrill—right and left valve.

Alectrion (Ilyanassa) obsoleta Say—2 specimens.

Chamæcyparis (cypress, white cedar) or *Thuja* (arbor vitæ).

The wood has in places a coating of blue clay as well as flakes of mica. The shells are discolored by a bluish clay.

The following is the section as sent with the specimens:

29.8 feet, high curb level.
10.7 feet, old cellar bottom.
0 feet, high water level.
22 feet, sand.
38.7 feet, hardpan.
55.5 feet, hardpan, sand, clay and boulders.
64.5 feet, hardpan, gravel and boulders.
67.8 feet, disintegrated rock.

Base of foundation of Federal Reserve Bank, bed rock—(core sample norite, possibly a phase of the Palisade trap). "This is undulating and varies from a depth as here noted to a depth of 117 feet below curb."

The shells were found 60 feet below the high water level, in the layer of hardpan, gravel and boulders.

The specimens of *Venus mercenaria* are thick, more rounded posteriorly than the recent shells of the same species and vary from the living form in that the concentric ribs are prominent, coarse, lamelliform ridges which extend over the entire surface of the shell, covering the middle region which in the recent shells is characteristically smooth. The characters are like those described by Verrill for forms from the Post-Pliocene of Sankoty Head, Nantucket Island, Massachusetts, to which he gave the varietal name *antiqua*. *Venus mercenaria*, with its numerous variations and mutations, dates back to Miocene time and is abundant to-day along the Atlantic coast, ranging from Florida to Massachusetts, and locally on the southwest coast of Maine and southern shores of the Gulf of St. Lawrence and Bay of Chaleur, from low water to 8 fathoms. *Ilyanassa obsoleta* also ranges from Miocene to Recent. Both of these species have been reported from well drillings on Long Island, including east New York City. They are from Pleistocene sediments (Veatch, Merrill, etc.). *I. obsoleta* is to-day one of the common small species of the east coast and ranges from Nova Scotia to Tampa, west Florida, from littoral to 2 fathoms.

The specimens are interesting in that they indicate marine sedimentation within the limits of New York City in Pleistocene or Glacial time. A further and exact study of the sediments of the section at the locality where the shells were discovered might reveal at what stage of that time the marine deposition took place and if the sea occupied the region where the shells were found or if they were transported by flowing water from a near beach and dumped with the drift and bowlders. The officials and workmen connected with the Federal Reserve Bank are to be commended for the collection and interest which they have shown, the result of which is the establishment of a new locality of Pleistocene marine sediments in the New York City area.

KATHERINE VAN WINKLE PALMER
CORNELL UNIVERSITY

EVOLUTION IN WEST VIRGINIA

BY special invitation, Honorable William Jennings Bryan recently addressed the legislature of West Virginia while it was in session at Charleston. Following this address Mr. Bryan made a tour of the state and gave anti-evolution addresses in several of the larger cities.

A bill prohibiting the teaching of evolution in all state-supported schools had already been introduced into the legislature. Just before the adjournment of the regular session, in the latter part of April, an advocate of the measure attempted to have the bill brought before the House, but the motion was lost and the bill was never allowed to come to vote.

It is stated that the address of Mr. Bryan in Charleston made practically no impression upon the members of the legislature.

One of the bitterest and most active opponents of the teaching of evolution, a minister of Morgantown, has been called to a higher sphere of usefulness (?) in Cincinnati and it is hoped that the anti-evolution agitation in the state has been permanently disposed of.

A. M. REESE

THE REPORTED ERUPTION OF LASSEN PEAK

SEVERAL times within the early months of this year Lassen Peak has been reported by newspapers of that region as in volcanic eruption. To settle conflicting reports I requested George Olsen and Charley Yori, well-known mountaineers of California and Alaska, to climb snow-clad Lassen Peak and determine the record, if any, made by the fall of volcanic ashes in the winter snow. Their letter of May 2 states: "There has been no eruption, as the snow is clean, no visible ash line in it and the crater where the eruption is supposed to have been has clean snow several feet deep covering the entire bottom of it and all other places where an eruption might have occurred show no sign of an eruption."

J. S. DILLER
Geologist
UNITED STATES GEOLOGICAL SURVEY

QUOTATIONS

PROPOSED INTERNATIONAL ASSOCIATION OF BRAIN WORKERS

SOME three years ago M. Henri de Jouvenel, one of the French delegates to the League of Nations, succeeded in establishing in France a *Confédération des travailleurs intellectuels.* This was the first national association of brain workers and now has 150,000 members; similar associations have been formed in eight other countries. A meeting of representatives of these associations was held recently at the Sorbonne, the headquarters of the University of Paris, with the countenance of the French government and under the honorary presidency of M. Léon Bourgeois, one of the most universally respected of French statesmen. It was attended also by "observers" from *nine* other countries.

Among the "observers" present were persons nominated by the several British societies, among others the British Medical Association, which was represented by Dr. Gustave Monod. The meeting first of all received communications with regard to the position in various countries and after a brief discussion it was decided to found a *Confédération internationale des travailleurs intellectuels*—that is to say, an international association of brain workers. A committee was appointed consisting of two delegates from each of the eight countries having an organized confederation, and an "observer" from each of the other countries represented; the latter having only consultative privileges. This committee was instructed to take steps to invite those countries which had not already done so to establish associations of brain workers and to draw up a constitution for the international association; the draft is to be submitted to the national organizations and afterwards considered at a meeting to be held in Paris before the end of this year. Dr. Monod informs us that medical societies in France are beginning to join the French confederation. The Association Générale des Médecins de France joined a short time ago and on April 11th the members of the Therapeutic Society of Paris, a purely scientific body, unanimously resolved to join also. Among the objects the organization has in view is the prolongation to eighty years of the period during which the author has a property in artistic and literary creations and to extend this principle to scientific workers. With this object it will seek to bring into existence an international code governing the right in intellectual property.—*British Medical Journal.*

SCIENTIFIC BOOKS

The Racial History of Man. By ROLAND B. DIXON. New York, Charles Scribner's Sons. 583 pages. $6.00.

DURING the last quarter of a century, particularly since the development of studies on heredity, the attempts to unravel the history of human types have been based more and more on the investigation of morphological forms. The more mechanical classifications according metrical features which dominated anthropological inquiry during the end of the past century do not play as important a part as they used to do. An excellent instance of this kind is the detailed investigation of the history of the Melanesian-Australian type given by Sarasin in his study of New Caledonia.[1] The same tendencies manifest themselves in the study of the ancient remains of man, particularly of those belonging to the paleolithic period. It is recognized more and more clearly that metrical values must be considered merely as a means of a quantitative statement of descriptive features.

Professor Dixon's attempt to unravel the racial history of man runs counter to this whole development. His book is based on the thesis that three measurements of the head—length, breadth and height—and two measurements of the nose—height and breadth—have remained stable since paleolithic times. The second hypothesis on which his analysis is based is the assumption that all those human types which are characterized by the extreme forms of the length-breadth and length-height index of the head and the height-breadth index of the nose are primary forms and that all intermediate forms are due to intermixture between these primary forms. In this way he obtains necessarily eight fundamental races, representing the eight possible combinations of three independent features.

From a biological point of view it is difficult to see how these two fundamental hypotheses could be maintained. First of all, we have no evidence that human types may be considered as absolutely stable. It is true that not all types of organisms react equally energetically to environmental influences, but there is no evidence that would permit us to assume that man is absolutely resistant to them. We have the best possible evidence that the size of the body and proportions of the limbs are strongly influenced by environment and, so far as I can see, no observations have been made that would contradict my own observations on the changes of head and face form of immigrants in the United States and of the descendants of Spaniards living in Porto Rico. The proof may not have been given that the differences between town population and country population observed in Europe is due to direct environmental influences, but even if we assume with Ammon[2] that it is due to selection, it would show that the constitution of a group of people may be materially changed.

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[1] Fritz Sarasin, Anthropologie der Neu-Caledonier und Loyalty-Insulaner, Berlin, 1916-1922.

The strongest argument in favor of the plasticity of skeletal form is shown in observations of domesticated animals. Changes in head form and in size of the skull have been observed not only in many domesticated animals, but also among animals born in captivity. Differences have been observed between wild lions and lions born in zoological parks and between wild rats and rats raised in cages. Attention has been called by Eduard Hahn and by the writer to the fact that men must be considered a domesticated form and this thesis has been most fully worked out by Eugen Fischer and recently by Berthold Klatt.[3] With these observations in mind, the thesis of the absolute stability of human forms from paleolithic times to the present would require proof before it could be accepted. This view is practically a restatement of the thesis of J. Kollmann, who considered the modern human types as "dauerformen."

In order to maintain the second hypothesis, Professor Dixon has assumed (page 17) that the three features which he discusses are not subject to Mendelian inheritance. While we do not know in detail how the three features are inherited, there is fairly conclusive evidence that there is a tendency towards reversion to parental types. A study of the data collected by Walter Scheidt[4] shows clearly that the formation of middle types as a result of crossings is not probable.

It would seem to the reviewer that an attempt to establish the extremes of a variable series as fundamental types is based on a misconception of the meaning of variability. We know from the studies of inbreeding carried out by Miss King[5] on rats and by Johannsen[6] on beans that even in extreme cases of long continued inbreeding there will always remain a considerable amount of variability. This is not surprising considering the complexity of the organism and the many ways in which it is subject to formative influences which can never be fully controlled. We are fairly familiar with the variability of the two head indices and of the nasal index. If we assume for a moment that we have a human type which, in regard to the three classes established by Professor Dixon, occupies exactly a middle position and if we assume furthermore that the variability in this group were equal to one half of the space occupied by the middle group and if, furthermore, we disregard the correlations between the various measurements, we should find that in a group of this kind all the extreme groups would be represented by 0.5 per cent. of the whole series; all the groups containing two extreme forms and one middle form would be represented by 1.8 per cent.; those representing one extreme and two middle forms each by 7.6 per cent. and those representing three middle forms by 28.7 per cent. As a matter of fact, the variability here assumed for the three ratios considered by Professor Dixon is lower than the normal variability that occurs in any given type and we would have to say, therefore, that in a group of people of this kind all the extreme forms would be represented. Professor Dixon would go on and say that all the middle forms are mixed and he would thus obtain 12.5 per cent. for each one of his primary types as the ancestry of the group. The assumption that the variability of a series of this kind is due to mixture is entirely arbitrary. In short, the proof is not given that the extreme forms are actually fundamental forms. On the contrary we should rather be inclined to assume that the extreme forms are due to certain excessive conditions that determine the particular form of the individual in question.

It seems, therefore, that the theoretical basis of the whole investigation would require proof of the two fundamental hypotheses and this the author fails to give and it is my belief that it cannot possibly be given.

It is, of course, true that the human races have intermarried to such an extent that the attempt to find a pure race anywhere is futile. Notwithstanding this fact, we ought not to overlook the similarity of the phenomenon to the analogous variability of plants and animals which occur over extended areas. Exactly the same method might be applied to forms of bears or to forms of mice. Here also extreme forms might be established and all the intermediate forms might then be explained as due to mixture. This simplification of the problem would, however, hardly appear justifiable because here, also, the dogmatic assumption would be made that the forms are permanent and not in any way subject to environmental influences.

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[2] O. Ammon, Zur Anthropologie der Badener, Jena, 1899.

[3] Mendelismus, Domestikation und Kraniologie, *Archiv für Anthropologie*, 1921, xviii, 225.

[4] Familienkunde, Munich, 1923, pages 75-109.

[5] Studies on inbreeding, Philadelphia, 1919.

[6] W. Johannsen, Elemente der exakten Erblichkeitslehre, Jena, 1909.

The difficulties of these hypotheses made by the author appear very clearly when he compares his fundamental types as occurring in different parts of the world. As might be expected he does not find any kind of correlation between the ratios which he studies and other anatomical traits such as pigmentation, hair form and so on. It is quite obvious that when we compare long-headed, high-headed, flat-nosed individuals living in the Alps of Europe with similarly proportioned individuals from Australia and West Africa, there must be serious differences in regard to other traits. Because Professor Dixon assumes that these three values are fundamental, he is compelled to assume that none of the other traits are permanent and are all subject to change. No attempt is made to prove this conclusion which is merely an inference drawn from the assumed permanence of the given traits. It is, of course, true that there is a possibility that features like kinky hair may have developed independently in different races, as Sarasin assumes, but this assumption does not overcome the objections based on the failure to consider any other bodily features.

On account of our fundamental disagreement with the general position of the author it does not seem advantageous to enter into a detailed discussion of the distribution of the various types which is given in a number of maps. It must be understood, of course, that the maps are analogous in character to the usual maps showing the distribution of, for instance, short statures and tall statures, or low cephalic index and high cephalic index and that all of these are only fragmentary reproductions, because the plotted values depend upon two factors, the average and the variability of the measurements. The author's maps ought to be labeled as expressing approximately the frequency of occurrence of certain combinations of features. The maps certainly do not prove that these are fundamental races.

It is quite impossible to check up the data contained in the book because the general tables are not given. This is obviously impossible in a book which evidently is intended to appeal not only to the specialist but also to the general reader, but furthermore, the summary tables given on page 22 and those contained in the conclusion do not agree and the numbers are so small that any general inferences drawn from them seem rather risky.

In the final chapter Professor Dixon tries to prove that those groups which agree in regard to the selected ratios also agree in regard to other metric features. He uses for this purpose a series of fourteen measurements, eight of which are the length, breadth and height of the head and length and breadth of nose and the three ratios on which his whole system is built up. He tries to show that the six remaining measurements agree. One of these is the breadth-height index which is derived from the same material as the length-breadth and length-height indices. The others are the bi-zygomatic diameter, two facial indices, the gnathic index and the capacity of the skull. It is not surprising that the measurements on which his classification is based should agree fairly well. However, in my judgment, the rest do not show any satisfactory agreement, particularly considering the small number of individuals upon which the comparisons are based.

A word should be said also in regard to Professor Dixon's general attitude towards the question of the relation between racial ability and anatomical form. In one place he expresses himself as quite convinced that achievement proves hereditary ability (page 518). I can not consider this argument conclusive. If it were valid, then at different periods it would justify entirely different views. It is not very long since Russia would have seemed in cultural achievement very much inferior to western Europe. The conclusion as to racial inferiority is in this case contradicted by the considerable number of eminent scientists and artists produced by Russia since social conditions have changed. If the ancient Greeks or still earlier the Egyptians or Chinese had used the same argument, they would have classified the northern Europeans as belonging to an inferior race, incapable of ever attaining cultural eminence. The proof of racial superiority certainly has to be based on other evidence. It is curious to note that when it suits the author's emotional attitude he changes his argument completely and indulges in flings at the assumed claim of racial preeminence on the part of the Germans—an attitude which hardly helps to make convincing a treatise that attempts to be scientific.

Franz Boas

Columbia University

SPECIAL ARTICLES

PHYSICO-CHEMICAL BASIS OF PSYCHIC PHENOMENA

Ever since Galvani discovered the relation between an electric current and muscular action there has been a feeling among scientists that the nerves are electrical conductors and that nerve impulses are really electrical currents. There has, however, been no satisfactory explanation as to how the conductivity of the nerve could be changed by the action of narcotics and nerve stimulants, as it must be changed to account for the effect of these substances on nerve impulse and psychic phenomena in general.

The explanation of the action of these compounds on the nervous tissue is very simple and in accord with the known facts concerning the composition of nervous tissues and the chemical and physical properties of narcotics and nerve stimulants. It is also based on well-founded laws of physical chemistry and is subject to laboratory verification.

This explanation postulates that the nervous tissue, which is composed of from 10 to 15 per cent. of lipins and from 70 to 85 per cent. of water, is essentially a two phase system of two immiscible liquids. One of these phases is a water solution, the other is a lipin solution. The relative dispersion of these two phases will depend upon their interfacial tension and on their relative internal pressure.

Any substance which will dissolve in the lipin phase and lower its surface tension but will not dissolve in the water phase will have a tendency to cause the lipin phase to become more continuous and for the water phase to become less continuous. Since the lipin phase is a poorer conductor than the water phase the conductivity of the nerve will be reduced as the lipin phase becomes more continuous. Any substance that will produce this result will be a narcotic. On the other hand any substance which will dissolve in the water phase and lower its surface tension but will not dissolve in the lipin phase will cause the water phase to become more continuous and the lipin phase less continuous, thus increasing the conductivity of the nerve. Such a substance will be a nerve stimulant.

This hypothesis will coordinate the following well-known, but apparently isolated facts:

A. The nervous tissue has a very high percentage of lipins.

B.[1] In a two phase system where the phases are immiscible liquids, either phase can be made continuous by dissolving in them a substance having the proper distribution coefficient and at the same time having the desired effect on surface tension.

C.[2] The narcotic action of a compound depends on its distribution coefficient between lipins and water.

D.[3] Not all substances which have a distribution coefficient which shows them to be much more soluble in lipins than water are narcotic in their action. In addition to this solubility in lipins the substance must lower the surface tension of the lipin phase to be narcotic.

E.[4] Narcotics do not form a definite chemical compound in the nervous tissue but are adsorbed.

F.[5] Surface tension is a factor in the action of narcotics.

G.[6] Too great a preponderance of sodium over calcium in an animal will produce tetany.

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[1] Clowe's *Jour. Phys. Chem.*, xxix, 407, 1916.

[2] Overton, "Studien über narcose," Jena, 1901.

[3] Curliny, "Text-book of Pharmacology," p. 128, 1904.

[4] Moore and Roaf, *Proc. Roy. Soc.*, 73, 1904.

[5] Traube view as reported on page 48 of "The chemistry of synthetic drugs," by Percy May, 1921.

[6] Frederick F. Tisdall, Vol. LIV, 35, 1922.

H.[7] Narcotics lower the metabolism of nervous tissue.

I. Sodium increases the permeability of cell while calcium lowers it.

This hypothesis affords an explanation of the make and break of contact at the synapses. The contact is broken so far as conductivity is concerned, when the lipin phase is on the outside, that is, when it is continuous. The contact is made when the water phase is on the outside.

This changing of the phases of the water-lipin two phase system will also account for many other little understood phenomena of other living cells and brings into coordination many isolated facts in the field of biology.

If experiments which are now being conducted in this laboratory bear out the above hypothesis it will be of great value to those interested in the manufacture of synthetic drugs. It will give the neuro pathologist a real basis on which to work. But, still more important, it will give to the experimental psychologists the physical basis for nerve impulse for which they have been searching without success and will establish psychology as a truly natural science.

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THE NATIONAL ACADEMY OF SCIENCES

THE annual meeting of the National Academy of Sciences was held in Washington on April 23, 24 and 25, when the following scientific program was presented:

AFTERNOON SESSION

Important mammals and reptiles recently discovered by the Third Asiatic Expedition in the heart of Mongolia, and their significance: H. F. OSBORN.

Asiatic relationships of American Pliocene faunas: J. C. MERRIAM.

Preliminary report on the life zones of Ecuador: DR. FRANK M. CHAPMAN. A study of the results of the field work in Ecuador, extending over a period of ten years, confirms previous conclusions in regard to the zonal distribution of bird-life based on similar data from Colombia. Both the character of the avifauna and the altitude of zones in southwestern Ecuador have, however, been strongly affected by a branch of the Humboldt current which washed the Ecuador coast north to about 1 degree S. lat. Four life-zones exist in Ecuador between sea-level and snow-line, a tropical, subtropical, temperate and paramo. The tropical zone in eastern Ecuador is wholly humid and composes the Ecuadorian portion of the Amazonian fauna. The tropical zone in western Ecuador contains two strikingly unlike faunas, one of which is humid and of northern, the other of which is arid and of southeastern origin. The more northern, extending southward on the coast to about 30 degrees S. lat., is the southern end of the Colombian-Pacific fauna which occupies the tropical zone of western Colombia and eastern Panama. For the more southern part of the tropical zone of western Ecuador, the name equatorial arid fauna is proposed. Climatically, this is a transition area between the humid coastal region of Colombia and northwestern Ecuador, and the arid coastal area of Peru and northern Chile. The collections of Noble and explorations now in progress by Watkins for the American Museum indicate the important discovery that the characteristic bird-life of this fauna has been derived from the valley of the Maranon with which it has been faunally connected at a very recent period. The bird-life of the entire western, or Pacific portion of the tropical zone, is believed to be, geographically, of post-Andean origin. The subtropical zone, or zone of mountain rain-forest, lies between the altitudes of 4,000 to 5,000 and 8,000 to 9,000 feet on the eastern slope of the Andes, but on the southwestern slope the lower temperature produced by the Humboldt current brings the inferior limits of this zone locally down to 1,200 feet above the sea. The temperate zone has well-defined humid and arid divisions. The former includes the upper forested areas on both slopes of the Andes. The latter is contained in the treeless interandine tableland. Like the subtropical it reaches a lower altitude in southwestern Ecuador than in other parts of the republic, and in western Peru it actually falls to sea-level. The fourth, or paramo zone, lies between the upper limits of the temperate zone and the lower limits of snow. On the outer slopes of the Andes the trees of the upper margin of the humid temperate zone border the treeless slopes of the lower limits of the paramo zone. The bird-life of the former includes arboreal species presumably derived from tree-haunting, tropical ancestors. That of the latter is composed of terrestrial species, most of which have apparently come from the plains of the south temperate zone. The birds of tropical ancestry are, however, much more widely differentiated than those which originated in the south temperate zone, indicating that the degree of differentiation is related to the extent of environmental change rather than its distance from the place of origin.

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[7] Shiro Tashiro, "A chemical sign of life," 1917.

Studies of the larger tertiary foraminifera from tropical and subtropical America: T. WAYLAND VAUGHAN. For more than a year I have been principally engaged on an investigation of the tertiary larger foraminifera of America in order to make more secure the basis of certain geologic correlations, to extend the correlation ring in the Caribbean region, and to work out in more detail the morphological features of the species of several genera, especially the genus *Lepidocyclina* and its allies. Some of the results of these investigations will be reported.

Interrelationships of the higher invertebrates: A. H. CLARK (introduced by L. O. HOWARD).

Recent discoveries of ancient man in Europe: ALEŠ HRDLIČKA. Under a grant from the Joseph Henry Fund of the National Academy of Sciences and upon conclusion of his work as chairman of the American delegation to the twentieth International Congress of Americanists at Rio de Janeiro, Dr. Aleš Hrdlička proceeded to Europe to examine the more recent discoveries of skeletal remains of early man and several of the most important sites where these discoveries have been made. In this quest Dr. Hrdlička visited Spain, France, Germany, Moravia and England. The important specimens studied included the jaw of Banolas in Spain; the La Quina site and specimens in southern France; the La Ferrassie skeletons, now beautifully restored, in Paris; the Obercassel finds in Brno; the Ehringsdorf discoveries and site at Weimar and at Ehringsdorf; the Taubach site near a village of that name, with the specimens at Jena; and the principal Predmost skeletons now preserved in the Provincial Museum at Brno, as well as the site of these important discoveries at Predmost (in northern Moravia) itself. In addition to these, thanks to the courtesy of Dr. Smith Woodward, Dr. Hrdlička was enabled to submit to a thorough study the Piltdown remains at the British Museum of Natural History and to see there the originals of the Boskop skull as well as the highly interesting Rhodesian skull and parts of skeleton from South Africa. He was finally once more able to see, at the Royal College of Surgeons, London, the originals of the Galley Hill and Ipswich skeletal remains. The examination of the specimens and the visits to the sites where most of them were discovered produced a deep impression on the one hand of the growing importance as well as complexity of the whole subject, and on the other of the vast amount of the deposits in western and central Europe bearing remains of early man and giving great promise for the future. It was also once more forcibly impressed upon the mind of the observer how much more satisfactory is the handling of the original specimens than of even the best made casts. So far as the scientific results of the trip are concerned, Dr. Hrdlička feels confident that he was able to reach a definite conclusion and position as to the human nature of the Piltdown jaw; and to satisfy himself on the more or less intermediate nature, between Neanderthal and the present type of man, of the Obercassel, the Predmost and some other crania; and to see the admirable restorations of both the La Ferrassie and the very important La Quina discoveries, the latter including the highly interesting and, so far as ancient remains of man are concerned, unique specimen of a skull of a child. Plaster casts of nearly all the important specimens not yet represented in the U. S. National Museum were obtained for the institution.

Heredity of body build: C. B. DAVENPORT. Body build is measured as chest circumference in relation to stature. If data concerning chest circumference are absent and weight is known the closest relation to the relative chest girth index is that obtained in adults by dividing weight by the square of stature. Build varies physiologically from birth to maturity. Relative chest girth is about two thirds stature in the infant, declines to 47 per cent. of stature at 12 or 13 years of age and rises on the average to about 53 per cent. in the third decade of life. Stature becomes more variable from infancy to adolescence and then declines in variability into the third decade of life. An analysis of various types of mating of parents of known build with known grandparents leads to the conclusion that fleshy build usually depends upon two or more gametic factors, although there is a type of heavy build that depends upon only one. In general, it is concluded that build depends on multiple factors and that the factors that make for heavy build are dominant over their absence or those which make for slender build. The evidence for this conclusion rests upon relatively small regression in the offspring of very slender parents, as compared with very fleshy ones, the relatively greater variability of the offspring of fleshy parents as compared with slender ones and various findings in the first and second filial generations from matings of parents with dissimilar build.

Parasitism and evolution: CHARLES A. KOFOID. The digestive tracts of termites or white ants are crowded with teeming hordes of microscopic parasites belonging to the flagellated protozoans distantly related to those found in the blood of cattle in the tsetse fly disease and to those occurring in the diarrheas of mammals, including man. These parasites occur only in those white ants which eat wood and have the power in association with bacteria to hydrolyse the wood. These parasites live in this fluid, which is viscous. The striking thing about the more than a hundred kinds of parasites found in the termites is the fact that they have undergone an evolutionary development of an order of magnitude which in diversity of structures developed and degree of progress attained outruns a hundred fold that which their free-living ancestry and most of their parasitic relations have attained elsewhere. These parasites live compactly crowded together and are ceaselessly moving and rubbing each other. Their evolutionary development consists in an extraordinary increase in number and structural complexity of the nervous and locomotor organs apparently in response to the specialized parasitic type of life in a viscous medium. The organs most stimulated by this mode of life have evolved to a degree without parallel elsewhere in the group to which they belong. The result is the evolution of a number of orthogenetic series of increasingly complex species along diverse lines in each of which a number of the successive steps are still preserved. These animals seem to lack entirely the power of sexual reproduction and therefore may not utilize the advantages arising from the Mendelian laws of genetics. The parasitic environment, the viscous medium in which they live, and the excessive functioning of certain organs are the tools which nature has used in moulding the evolution of these strangely developed organisms. The fact that the neuromotor system, which is so excessively developed in them, is directly and continuously connected with the nucleus, the carrier of hereditary qualities, is significant in this connection.

The nature of resistance to cereal seedling blight: J. G. DICKSON (introduced by L. T. Jones).

Ancient high-level potholes near the Colorado River: F. L. RANSOME. Black Canyon is a narrow and deep gorge cut by the Colorado through a series of andesitic lavas a few miles south of the point where the river turns from a general westerly course to flow nearly due south to the Gulf of California. At the request of the U. S. Reclamation Service, the canyon was examined late in 1922 with a view to determining its suitability from a geological point of view as the site of a high dam. The topography of the canyon suggests that it was rapidly cut in late geological time. Certain faults, that is, fissures, along which there has been movement of the rock on one side relatively to the rock on the other side, appear in the canyon walls. The character of these faults suggests that no recent movement has taken place along them. It is important that the rocks at a dam site should have practical immobility. Accordingly additional evidence was sought to show that the faults are not now active. This was found in the occurrence of typical water-worn potholes and smooth channels, worn in hard andesite, on the brink of the gorge, about nine hundred feet above the present water surface. These were the work of the Colorado before it cut Black Canyon. Some of the smooth channels were cut across one of the faults exposed in the canyon walls. As the channels have not been dislocated it is evident that there has been no movement on this particular fault during the time occupied by the river in cutting down nine hundred feet. The excellent state of preservation of the potholes corroborates the conclusion drawn from other evidence that the cutting of the gorge was, in a geological sense, a rapid process.

The evidence of recent tectonic movement within an area of the western Pacific: W. H. HOBBS (introduced by H. S. Washington).

Geological overthrust and underdrag: W. M. DAVIS.

The marginal belts of the Coral Seas: W. M. DAVIS.

EVENING SESSION

Address: *Résumé of results obtained by the Crocker eclipse expeditions from Lick Observatory:* DR. W. W. CAMPBELL, Auditorium, U. S. National Museum.

TUESDAY, APRIL 24

MORNING SESSION

Symmetric tensors of the second order whose first covariant derivatives are zero: L. P. EISENHART.

Birational transformations simplifying singularities of algebraic curves: GILBERT AMES BLISS. There is a famous old theorem in the theory of algebraic curves which states that every such curve can be transformed by a birational transformation into one which has no singularities except double points with distinct tangents. The theorem is not a simple one to demonstrate, and many of the proofs which have been given are incomplete or inaccurate. In a preceding paper, to appear in the *Bulletin* of the American Mathematical Society, the author has commented upon these proofs and has signalized two of them as being especially interesting. One is by Walker, who developed an alteration, suggested by Klein in 1894, of a method originally devised by Bertini for the projective plane. In the second, by Hensel and Landsberg, reasoning proposed by Kronecker in 1881 is extended to apply to curves in the function-theoretic plane. Both of these proofs are lengthy and complicated when all the details are taken into consideration. In the present paper the author has remodeled the method of Kronecker so that it can be applied to both planes, and has attained what he hopes will be regarded as simpler proofs of the two theorems.

On the approximate solution in integers of a set of equations of the first degree. Second paper: H. F. BLICHFELDT. To the theorem read by the author at the meeting of the academy on April 26, 1921, is now added the following: Let $F_1, F_2, \ldots, F_{n-1}$ represent $n-1$ linear and homogeneous expressions in n unknowns $x_1, x_2, \ldots, x_n$, of such a nature that no set of numbers $c_1, c_2, \ldots$ (not all $= 0$) exist for which $c_1F_1 + \ldots + c_{n-1}F_{n-1}$ would be rational in all the coefficients of $x_1, x_2, \ldots, x_n$; furthermore, let there be given a set of n numbers $b_1, b_2, \ldots, b_{n-1}, \varepsilon$. Then integers exist which, when substituted for the unknowns $x_1, \ldots$, will solve the equations $F_1 = b_1 \ldots$, $F_{n-1} = b_{n-1}$ approximately, the errors being all less than ε in absolute value. Moreover, the product of the errors is less than N/R, where N is a certain number depending only upon the coefficients in $F_1, \ldots, F_{n-1}$ and $R = \sqrt{(x_1^2 + x_2^2 + \ldots + x_n^2)}$.

Properties of path curves in the Einstein theory: E. KASNER. If a family of curves is given at random it will not usually be possible to obtain a Weyl geometry (or more specially an Einstein geometry) in which the curves are the paths of natural motion. A necessary (and for the Weyl geometry a sufficient) purely geometric condition is obtained in Professor Kasner's paper. If the curves are represented in any way in euclidean space the orthogonal projections of the curves touching a given plane at a given point have their centers of curvature on a cubic curve of special type (the given point is a conjugate point with the minimal lines as tangents).

The synthesis of new cinchophen (atophan) types: M. T. BOGERT.

The synthesis of new rose alcohols of geraniol type: E. M. SLOCUM and M. T. BOGERT.

Researches in the thiazole field: M. T. BOGERT.

The exchange of oxygen and carbonic acid between blood and air (illustrated): L. J. HENDERSON.

The relative physiological action of various kinds of protein: D. L. RAPPORT (introduced by Graham Lusk).

The components of amplified nerve action currents demonstrated by means of the cathode ray oscillograph: JOSEPH ERLANGER and H. S. GASSER. Action currents of mixed nerves recorded by this method are shown to be compounded of two or more waves of potential originating simultaneously at the site of stimulation, but propagated at different rates.

Recent problems in radiation: R. W. WOOD.

The limit of accuracy in optical measurement: A. A. MICHELSON.

Tracks of alpha particles: W. D. HARKINS.

Isotopes and atomic stability: W. D. HARKINS.

AFTERNOON SESSION

A study of motions in double stars: H. N. RUSSELL.

Irregularities in spectroscopic binary orbital curves: H. D. CURTIS.

The trigonometric parallaxes of 350 stars determined by photography with the 26-inch McCormick refractor: S. A. MITCHELL (introduced by C. G. Abbot).

Some results of the Yale photographic meteor campaign: C. P. OLIVIER (introduced by Frank Schlesinger).

Pressures at the sun's surface: H. N. RUSSELL and J. Q. STEWART.

The solar prelude of an unusual winter: C. G. ABBOT and colleagues. Does the sun's variation influence the weather? If so, the year 1922 and following months ought to show it. The general mean of "solar constant" values determined by my colleagues and myself at the two Smithsonian Institution solar observing stations, Mount Harqua Hala, Arizona, and Mount Montezuma, Chile, are given below. These observations cover all months from October, 1920, to September, 1922. The extraordinary drop of solar values during 1922 at once is apparent. It is confirmed at both stations. The general mean of solar constant values, in calories, was: October, 1920, 1.948; November, 1.949; December, 1.955; January, 1921, 1.958; February, 1.951; March, 1.946; April, 1.947; May, 1.949; June, 1.954; July, 1.945; August, 1.936; September, 1.944; October, 1.947; November, 1.954; December, 1.951; January, 1922, 1.945; February, 1.946; March, 1.934;

April, 1.927; May, 1.927; June, 1.917; July, 1.911; August, 1.917; September, 1.907. A tabulation of the mean monthly values for the past four years, as determined at Calama alone to July, 1920, and thereafter at Montezuma and Harqua Hala, would show prevailingly high solar constant values until 1922, usually exceeding the normal solar constant value of about 1.94 calories as we have determined it. The figures show that nothing so outstanding as the change of 1922 to low values has occurred in all that interval. Indeed, nothing so marked has occurred since we began these observations in 1905, so far as our Mount Wilson work can show. That work, however, was fragmentary. Low solar radiation values continued to prevail in later months of 1922 and early months of 1923, as results yet unpublished will show. A full account of the individual values here summarized may be found in Volume IV of the Annals of the Astrophysical Observatory of the Smithsonian Institution, supplemented by a forthcoming detailed publication to appear as a supplement of the U. S. Weather Bureau's *Monthly Weather Review*. All this being so, has anything unusual occurred in weather conditions which may have been connected with solar changes? We are not to look for anything so simple as a general drop of temperatures all over the world. Oceans, deserts, mountains, clouds and winds make up too complex a system for such simple reactions. Profound departures of some sort from normal conditions, however, we might expect. It will be recalled that the prevailing characteristic of the weather of the United States for the last couple of years or more is a condition generally warmer than normal. Thus from the summary for 1921, U. S. Weather Bureau, Climatological Data: "The outstanding feature of the year was the unusually warm weather in nearly every month. The annual mean temperature was 66.3 degrees, or 2.7 degrees above the normal, making it the warmest year since the beginning of the state-wide records." The monthly reports for 1922, while less pronounced in this sense, indicate warmer than normal conditions on the whole. We start, then, with an excess of heat. Quoting now from "Climatological Data": "The record of December, 1922, shows unusual contrasts as to the temperature and precipitation in different parts of the country. In the southeast it was the warmest or almost the warmest December for thirty years or more, while in the far northwest it was the coldest December in a like period. The precipitation over Tennessee, Mississippi and considerable parts of the states adjoining was about as great as ever yet recorded there in December, while an area centering in Kansas had no precipitation or practically none."

Note on the visible radiation from germanium oxide and on its melting point: E. L. NICHOLS. In the experiments to be described the oxide, mounted on an alundum block, was treated in an oxy-hydrogen flame. The brightness of three regions of the spectrum—red, green and blue—was measured at intervals of about fifty degrees throughout the range from a red heat to the point of fusion. Germanium oxide does not have the remarkable property first noted by Ch. Fery in certain other oxides, and recently studied in some detail by Dr. Howes, the present writer, of radiating selectively at certain temperatures with intensities greatly in excess of the corresponding "black body" brightness. Its departures from normal radiation are, however, very striking. At the lowest stages of incandescence the red is almost absent (at 700 degrees C. less than one per cent. of black body brightness), whereas the blue nearly equals the blue in the spectrum of a "black body" of that temperature. At 1,200 degrees C. the reverse is true, *i. e.*, the blue of the spectrum is less than one per cent. of "black body" brightness and the red equals the corresponding intensity of the "black body." The oxide is therefore *blue* at the "red heat" and *ruddy* when "white hot." At an intermediate temperature of about 1,050 degrees the radiation is non-selective—having the distribution of a black body spectrum and an intensity of about forty per cent. At 1,400 degrees C. the beginnings of fusion became apparent in the field of the optical pyrometer and until more precise measurements are available that temperature may be taken as the approximate *melting point* of *germanium oxide*.

Electric conduction: E. B. WILSON. According to the free electron theory of electrical conduction the conductivity is proportional to the number of free electrons per cubic centimeter. According to a theory recently developed in a series of papers presented to the National Academy and published in their proceedings, Dr. E. H. Hall has proposed to take into account not only the free electrons but the residual charged atoms from which the electrons have departed. He finds that the major part of the conductivity appears to be due to the behavior of these residual positively charged atoms instead of to the free electrons. On the free electron theory it is reasonable to suppose that a negatively charged conductor might be very slightly more conducting than in the neutral state. On Hall's theory it is reasonable to suppose that a negatively charged conductor should be slightly less conducting than in the neutral state. Professor Henry Perkins, of Trinity College, working in Langevin's laboratory last year, found (albeit with a very delicate experiment) that apparently a negatively charged conductor became less conducting and a positively charged conductor more conducting. If this experiment should be substantiated it would seem to be additional support for Hall's theory. Professor Wilson discusses the matter theoretically.

The quasi-equation $P = T\frac{dV}{d'T}$: Edwin H. Hall. The P is the Peltier effect, the V is the Volta effect. Lord Kelvin, to whom the equation, if it can be called such, is due, found that it was very far from being verified by experimental evidence and concluded that something had been over-looked in the argument. Compton's experiments (*Physical Review*, Vol. 7, 1916, p. 209) on nickel and iron made the ratio of the two sides of the equation about fifty. The paper now offered will propose an amendment, on theoretical grounds, making the two members much more nearly equal.

The thermal conductivity of metals under tension: P. W. Bridgman.

The transfer of radiation momentum in quanta to matter: William Duane.

Further experiments on the mass of the electric carrier in metals: Richard C. Tolman. The production of an electromotive force by the acceleration of a metallic conductor was apparently demonstrated by the work of Tolman and Stewart, by measuring the pulse of electric current produced by suddenly stopping a coil of wire rotating around its axis. The purpose of the work described in the present article has been twofold. In the first place it seemed desirable to obtain a new demonstration of this production of an electromotive force by the acceleration of a metal, using some method of attack as different as possible from that of Tolman and Stewart, in order to increase our certainty as to the reality of the effect. In the second place, it seemed desirable to try to find a method which would eliminate direct electrical connections between moving and stationary parts and would avoid the sudden stopping of a coil of wire, with the attendant chance of irregular electromotive forces due to buckling or slipping of the wire. The apparatus finally used consisted of a copper cylinder 9⅛ inches long, 4 inches outside diameter and 3 inches inside diameter, oscillating about its axis with a frequency of 18.9 cycles per second. Surrounding this copper cylinder was a coil containing about 60 miles of No. 38 copper wire (diam. 0.1 m.m.), which acted as the secondary of a transformer. Connection from this secondary was made through a specially designed three stage amplifier with a vibration galvanometer. The tendency of the electrons in the oscillating copper cylinder to lag behind because of their inertia leads to an electromotive force, the effects of which were finally measured by the deflection of the vibration galvanometer. These galvanometer deflections were then compared with those produced by the known electromotive force accompanying transverse oscillation of the cylinder in such a way as to cut the earth's magnetic field.

"Permalloy," a supermagnetic material: H. D. Arnold and G. W. Elmen. This material, an alloy of nickel and iron, is more easily magnetized than any previously known, its susceptibility in weak fields being many times that of the best soft iron or silicon steel. Because of its extraordinary magnetic permeability it has been given the name "permalloy." The sensitiveness of its magnetic and related properties to heat treatment and to mechanical control adds to its scientific interest. In the electrical arts and especially in telephony and telegraphy it promises great advances, among which is a revolutionary change in submarine cables.

Some recent measurements of Trans-Atlantic radio transmission: Ralph Brown. During the winter of 1922-23, measurements have been made in London of signals received from the radio station at Rocky Point, Long Island, U. S. A. The transmission was at a wave length of 5,300 meters (frequency 57,000 cycles per sec.) using a continuous wave. In London the measuring apparatus determined the absolute value of the electric field of the received radiation. The electric field of the radiation was also measured at a point in New Jersey to get a check on the amount of radiation sent out. Curves are given showing the typical daily variation of the transmission during January, February and March, 1923. The data are the most complete of their kind yet published.

New telegraph alphabet: George O. Squier. From these measurements it was possible to calculate the ratio of mass to charge for the electric carrier in copper. Within the limits of experimental error this ratio was found to be the same as that for an electron in free space.

Biographical memoir of Harmon Northrup Morse: Ira Remsen (by title).

Biographical memoir of Samuel James Meltzer: W. H. Howell (by title).

Biographical memoir of Alexander Smith: W. A. Noyes (by title).

Biographical memoir of J. C. Branner: R. A. F. Penrose, Jr. (introduced by C. D. Walcott) (by title).

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AGRICULTURAL RESEARCH AS A CAREER

THE production, storage and distribution of an adequate supply of food and raw materials constitute the primary function on which all civilization has been founded. The raw materials are at the present time of various kinds. Primarily they had to do with clothing and shelter, so cotton, wool, leather and wood have always been the major products. The number of products used for food and raw materials has increased from time to time and the proportion has varied as opportunities for new uses and wider distribution have developed. While adding to the total of production and consumption, they have not materially changed the dependence of the world upon the staples of centuries past.

During the past century America has been producing an excess of food. She has offered opportunity for development to her own growing population and to the crowded populations of Europe. As long as there was an abundance of rich and fertile land available for cultivation, the major effort of agricultural research has been to increase the production per man and that effort has been so highly successful that one agricultural worker can to-day produce four or five times as much food as his grandfather could. The major portion of the nation's rich and fertile acres has now been taken up. If this nation is to continue to develop for another century, as she has during the past, those engaged in agricultural research must redouble their efforts and increase the production per acre as they have in the past increased the production per man. The European nations reached this condition a long while ago and those nations that recognized the problem and put forth the greatest efforts in the development of food production have grown the most rapidly in wealth and power. The field of agricultural research therefore offers to the coming generation of scientific workers a wonderful field for individual advancement and, at the same time, outstanding opportunity for national service.

AGRICULTURAL RESEARCH EMBRACES MANY FIELDS

Agriculture is not a single science but the application of many sciences to the agricultural problem. Almost every agricultural problem has a chemical and a biological phase. Many of them involve problems in physics, physiology, bacteriology and genetics. The soil problems lead into geology, while irrigation and drainage have many relations with engineering. The biological sciences have been split into many fields, such as plant pathology, entomology, parasitology, as well as applied subjects such as agronomy, animal husbandry, horticulture, forestry and dairying.

WHO SHOULD UNDERTAKE AGRICULTURAL RESEARCH?

Those who love nature, who take a keen delight in plants and animals, who are interested in life's varied manifestations, who love the great outdoors and outdoor life should be especially interested in agricultural research. In a field as broad as this there is of course every variety of occupation, but in a large majority of the cases those who engage in solving the problems related to agricultural development keep closely in contact with the soil, the plant or the animal and at least a part of their work is of necessity in the open. Research in itself keeps the mind young and growing. Agricultural research affords opportunities that make for health, long life and the physical strength that is required for accomplishment.

The field of agricultural research is so broad that there is opportunity for every one who has a trace of the research spirit. Some position can be found into which one's abilities and capabilities can be fitted. The student, however, who desires to fit himself to reach the highest positions of responsibility, or to make the major contributions to the progress of science, must see to it that his educational foundation has been of the broadest and most fundamental character. Much of the research in the past has been on superficial problems. The great problems of the future are in the solution of fundamentals—problems in most cases involving many of the sciences—and the broader one's foundation in these sciences the more likelihood there is of unlocking nature's secret. Many a man has approached the threshold of a great discovery only to find himself baffled by his lack of training, while some other man with no greater ability but with a broader knowledge of methods of related fields has found the key and unlocked the door of knowledge.

THE QUALIFICATIONS FOR SUCCESS IN RESEARCH

A relatively small number of men and women go to college. A still smaller number should be encouraged to take up research work. Just what the qualities are that make up research ability are hard to define. No examination was ever devised that could determine. Brilliancy in student scholarship is no test. Darwin and Pasteur, two of the greatest research men of the last century, were indifferent students. In other cases, brilliant students have been brilliant research men. Scientific research requires absolute honesty and integrity of purpose. No man should look forward to a career in research who is not fundamentally honest and conscientious. A spirit of public service, of responsibility for the advancement of the nation or the race, is a major asset. A desire to cooperate with your fellows, ability to organize and direct the actions of others, all contribute to success. The vital outstanding factor that makes for success in research is vision, ability to look into the future, to keep an open mind, to hold all information as relative and subject to revision or new interpretation or even to be discarded, if the necessity arises, and an entirely new concept substituted. Vision carried to the extreme becomes visionary. Openmindedness in the same way becomes skepticism, and yet progress in the research field is conditional upon these attributes of mind. If they be well balanced and coordinated and accompanied by the other essentials there are almost no limits to the possibility of accomplishment. Without them there may be substantial accomplishment—many contributions to the sum total of human knowledge—but the great discoveries will be for others.

ADVANCED TRAINING

With the increasing complexity of all the sciences the research field is becoming more and more restricted to those who are especially trained for the work. In a complicated subject like agriculture this is especially true. The great advancements of the past have been made by those who have brought the best training to the problem and it is hardly worth while for any one to look forward to that field in the future unless he is willing to undertake adequate training for this service. A statistical study of those who have contributed most to their respective sciences shows that over seventy per cent. of them have earned doctor's degrees. These men represent the education of a generation ago when doctor's degrees were relatively rare as compared with the present time. If this is true to-day, how much greater will the percentage be in the generation to follow!

Three years of advanced training may at the first glance seem formidable. It is, however, relatively easy to obtain under existing conditions. At least one year of graduate work should be taken immediately after graduation. During this year the student will become familiar with the research problem in his major field and have extended his breadth of vision in two or more related lines. The results of this year's work should lead to a final determination as to whether or not he is fitted to enter a research career. If he has been reasonably successful in his major subject it will now be possible for him to obtain employment in the chosen field. That employment should be selected with reference to opportunity offered, rather than salary. A research position in an experiment station or government laboratory, or an assistantship in a scientific department with part time teaching and an opportunity for research, will give opportunity to further try out capabilities and inclinations. Two or three years' work of this kind, making use of every opportunity for acquiring additional training and experience and in demonstrating capabilities along administrative or cooperative lines, are of more value in determining success than are generally realized. Following this, two more years of graduate training under the direction of one of the great leaders in his chosen field should complete the fundamental preparation for his life work. By making use of a scholarship, a fellowship or an assistantship this can be accomplished with relatively small financial outlay. By this time the student will have learned that there is no end to study and development and that every opportunity of obtaining greater breadth of training and especially of making contacts with leaders in the related sciences should be embraced.

OPPORTUNITY FOR SERVICE

Despite the wonderful progress that has been made in the last generation, the opportunity for still further discoveries is unlimited. Every time a problem is solved, three or four new ones are opened up and any worker entering the field will find that there is a crying need for more knowledge on every hand. Who knows that we are using the best breeds of animals that can be developed? For the most part we have been content to continue with those our ancestors used, in many cases without material improvement. It is possible that the introduction of wild strains or the crossing of other domesticated species might easily give us the foundation for the development of still more economical producers than those we are using at present.

In the nutrition field every new investigation, instead of solving our problems, simply opens up further avenues requiring research. The discovery of the existence of vitamins explains why previous nutritional investigations were not conclusive, but the investigation is still to be made that will explain the vitamin.

The plow is one of the most ancient of agricultural implements. It is also one of the most modern. Recent investigations have shown that under certain conditions greater yields have been obtained by omitting the plow. We need to know more about the physics, the chemistry and the biology of plowing. The same is true of tillage in general. The crops of a generation ago have been largely superseded by more productive varieties. Is there any reason to believe that still more profitable forms can not be developed?

Notable progress has been made in bud selection in certain citrus fruits. This same process may be equally valuable over a much wider field of horticulture. The factors of productiveness and hardiness need much careful investigation to determine their causes. The forestry situation is becoming acute. Our fathers destroyed the forests to get rid of them. Our sons will have to develop anew what their ancestors destroyed. Reforestation involves problems in almost every field of science.

The present methods of control of insect pests have been almost entirely the development of a single generation. The field is as yet hardly touched. Almost every one of our major insect pests needs further investigation. The chemists should combine with the entomologist to study the attractiveness of different grasshopper baits and when they have solved this problem they will find an almost unlimited field in the development of attractive substances to assist in the destruction of injurious insects. The control of plant diseases needs the combination of the chemist, the plant physiologist and the pathologist to work out the intricate problems of the lethal relations of host and parasite. We have been working with a small number of standard insecticides and fungicides. Who knows that modern chemical research does not offer a dozen more efficient compounds than those in present use?

This country has established an enviable reputation for the success of its eradication programs. Contagious pleural-pneumonia, seven outbreaks of the foot-and-mouth disease and many small outbreaks of gipsy moth have been completely eradicated. The citrus canker has been eradicated from the commercial citrus growing regions and is rapidly being eliminated from the remainder of the gulf region. The sweet potato weevil has been greatly restricted in the commercial areas. The Texas fever campaign is approaching completion. The progress of the pink bollworm, the barberry and the tuberculosis eradication programs is very promising. These have been made possible by persistent research that has developed methods. Hog cholera, contagious abortion, the ox warble, the codling moth, the boll weevil and a host of other pests and diseases offer equally favorable opportunity for great national eradication movements as soon as the research workers have perfected the methods that will make them possible.

The discovery of the colloids has opened up a new field of investigation into hundreds of agricultural problems, few of which have as yet been touched. No one can predict the advances possible before this line is exhausted. Our ideas of the plants' sources of nitrogen are being constantly modified. Here is opportunity for exhaustive research. The recent developments in our knowledge of the relation of insects as transmitters of plant diseases and especially the recent discoveries of organisms connected with the mosaics open up a wonderful field of research in which many scientific groups must combine. The influence of meteorological factors on plant and animal development is an almost unworked field. The whole subject of the water requirements of plants, the movement of water in its relation to irrigation and drainage, need much further study. The chemist, the physicist, the biologist and the engineer are all needed in the solution of these problems.

The problems in production have been the major field of agricultural investigation in the past. With the concentration and specialization of populations the problems of marketing and distribution are becoming equally or even more important. The economist must now join forces with the other scientists in the solution of many of the most intricate problems. To further itemize would be superfluous. Every ramification of the field of agriculture offers wonderful opportunity for individual effort, as well as opportunity for contribution to national welfare and human development.

NOT NECESSARY TO GRADUATION IN AGRICULTURE

From the above outline of the problems it is readily seen that a comprehensive research into a complicated agricultural problem requires the services of men trained in many fields of research. The great contributions in most of the applied sciences, such as agriculture, engineering and medicine, have been made by those who have approached the problems through the pure sciences and this will probably be even more noticeable in the future as the superficial problems are solved and the fundamentals are undertaken. There is, therefore, no reason why a graduate who has majored in any of the fundamental sciences should not look forward to a career in agricultural research with every expectation that his chances of success will equal or exceed those who approach the problem from the standpoint of the more technical agricultural training.

WHAT A RESEARCH CAREER OFFERS

One of the first effects of the World War was to place the scientist and the teacher in an almost hopeless financial condition. One of the secondary effects has, however, been to bring to the attention of the people of all civilized countries the value of science and especially of organized research as an important factor in the preservation of their national unity. The final result promises to be an increased opportunity and recognition for the scientist in general and especially an appreciation of the increased necessity for continued research in the development of any industry.

For the man just out of college or having completed a single year of graduate work, the greatest opportunity will usually be in connection with the educational institution or government bureaus. A few years' experience with its accompanying accomplishment and broadening of vision, combined with educational training, will place the individual in line for further advancement in these organizations or for opportunity to enter the commercial field. With the present trend in salary standards, the research scientist in agricultural lines may look forward to a relatively early opportunity to enjoy a salary that will support his family in reasonable comfort and still allow a margin for accumulation. As he advances in his profession and gains a position of leadership the margin of possible accumulation will increase rapidly. By this time his position will give him social standing and opportunity that others can only purchase by the expenditure of much larger sums of money. In addition, with the growing recognition of the value of the work of scientific men, larger and larger financial rewards are being paid to the best men.

E. D. BALL
DIRECTOR OF SCIENTIFIC WORK
UNITED STATES DEPARTMENT OF AGRICULTURE

THE ART OF MEDICINE

IN the dome of the magnificent structure of contemporary medical education, across the ceiling, are inscribed the words, "Mene, Mene, Tekel, Upharsin."[1] Below, in the alcoves of laboratory science, there may be made out, perhaps less distinctly, the words, which, traced by the Hand, foretold the fall of Babylon: "Thou art weighed in the balance, and art found wanting."

A writer on the medical art, rich in the modern spirit, but not contemporary with us, has said[2] "This is the great error of our day in the treatment of the human body, that physicians separate the soul from the body."

The idea that the patient is a person who is sick, and that the healing art is to make a sick person well, will dominate the medicine of to-morrow, whether the art is applied in time to prevent, or only so late that cure is not possible.

Just now the point of view of psychobiology is becoming recognized as the one from which the physician must regard his patient.[3] How can the student of medicine get this point of view? Best, by example, from his teachers who have it, who treat patients as persons in distress, with dis-ease, seeking the physician for relief. But also, more formally, by a study of the personality as Meyer has indicated.[4]

This point of view involves a reorganization of the medical curriculum. The logic of the present arrangement is clear. It is to study structure, then function, then defective or "diseased" structure and function; and finally, cases of disease, applying the already acquired knowledge of structure and function.

The reorganized curriculum will have a different logic. The patient, a sick person, will be studied first and chiefly. On the hypothesis that function and structure are inter-related, the student will use pre-laboratory methods, and then will go to the laboratory to get help in solving problems which the patient presents. The student will begin with the obvious, or more nearly obvious and go on to the less obvious, or the hidden. He will learn first to use his own senses, then try instruments of greater or less precision.

The course in clinical medicine will be the major course for the four years. It will be the only major course, comprehending surgical therapeutics as well as the other forms of

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[1] Daniel, v. 25.

[2] Plato-Charmides, translated by Jowett.

[3] Yerkes, R., "Relation of psychology to medicine," SCIENCE, Vol. liii, No. 1362.

[4] Meyer, A. See Curriculum of School of Medicine, Johns Hopkins University.

FIG. 1. FIRST YEAR

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture
10	Clinic	Clinic	Clinic	Clinic	Clinic	Path. Lab.
11	Clinic	Clinic	Clinic	Clinic	Clinic	Path. Lab.
12	Clinical Lecture	Clinical Lecture	Clinical Lecture	Clinical Lecture	Clinical Lecture	
1						
2	Lecture	Lecture	Lecture	Lecture	Lecture	
3	Anat. Lab.	Anat. Lab.	Physiol. Lab.	Physiol. Lab.	Path. Lab.	
4	Anat. Lab.	Anat. Lab.	Physiol. Lab.	Physiol. Lab.	Path. Lab.	

therapy now taught as specialties. The laboratory branches will be supplementary, accessory, subsidiary.

This may be set forth in a skeleton schedule (Fig. 1). For convenience in schedule making the laboratory sciences may be put into three groups, the anatomy group, the physiology group and the pathology group. Devoting the morning of five days in the week to clinical exercises, and the afternoon and Saturday morning to laboratory studies, gives six laboratory periods in each week. These may be combined to form three units. The schedule for the first three years, with three groups of studies and three units of time, may be outlined easily.

Five days would be arranged as follows: The first hour (9-10) would be a didactic lecture; the hours from 10 to 12 would be devoted to the study of patients (bed patients, outpatients, patients in the districts); from 12 to 1 there would be a clinical lecture; intermission from 1 to 2; from 2 to 5, laboratory work preceded by as formal a talk as the instructor desired. This would reduce the didactic lectures to two a day at the most, from 9 to 10 and from 2 to 3.

In the second year and in the third year the student would have the same laboratory groups, with the shifting of period as shown in the diagram. (Fig. 2). The fourth year might well be left for electives.

This scheme might be utilized in a complete school of medicine. The course as outlined would be followed by all students for two years. At the beginning of the third year, specialization in dentistry, public health or industrial medicine could be undertaken, and two years, or the second half of the course, might be thus employed. The two years in the clinics with training in the general laboratory branches would be of great value to the dentist or doctor of public health. The "practitioner" would devote four years to clinical medicine.

What about research? There is some confusion of thought here. "Many are called but few are chosen." The capacity for adding to the sum of human knowledge is a rare gift. The capacity for adding to one's own knowledge is possessed by every medical student. So the

FIG. 2.

	First Year	Second Year	Third Year
Anatomy Group	Monday and Tuesday	Wednesday and Thursday	Friday and Saturday
Physiology Group	Wednesday and Thursday	Friday and Saturday	Monday and Tuesday
Pathology Group	Friday and Saturday	Monday and Tuesday	Wednesday and Thursday

spirit of research should be in every student. If he does not have this, medicine is not for him. But let us not think we yet know how to select from the thousands who wish to study medicine each year a few groups of fifty or sixty, for a few schools, so that in each group there shall be even five "righteous" persons, *i. e.*, capable of adding to the sum of human knowledge.[5]

There are many and serious practical objections to the scheme I have indicated in outline, which I shall not take the time to consider now. I have intentionally avoided details. At the risk of being misunderstood, and seeming dogmatic, I have sought brevity. But from many quarters arise suggestions that the student should come in contact with patients earlier than at present. Why not be "simple minded"[6] and begin at the beginning?

STEPHEN RUSHMORE

TUFTS COLLEGE MEDICAL SCHOOL

PRESENTATION OF THE MARY CLARK THOMPSON MEDAL TO DR. EMMANUEL DE MARGERIE

AT the recent meeting of the National Academy of Sciences, the Mary Clark Thompson Medal was presented to Dr. Emmanuel de Margerie by Dr. Charles D. Walcott, president of the academy. In making the presentation Dr. John M. Clarke said:

It should be clearly understood that this award, based upon the foundation established by Mrs. Frederick F. Thompson, has for its purpose the recognition of full achievement in the sciences of geology and paleontology and while the award may encourage its recipient to further endeavor, this is not its first purpose. By the terms of the foundation, the Thompson Gold Medal shall go to him who has not failed in seed time nor in harvest and the fruits of whose labors are evident in the sheaves he has already reaped. This medal has been given but once before and then to Charles D. Walcott, the president of this academy.

Your committee has very cautiously filtered the world of geological achievement in its effort to fix upon the work and the author of the work most fitly to be crowned by this award. It has halted at no national boundaries and its decision has not been a hasty one nor arrived at by any devious crosscut. In consequence the committee has the pleasure of presenting to the academy for the award of this highest honor in these sciences in its gift Dr. Emmanuel de Margerie, former president of the Société Géologique de France, actual director of the geological service of Alsace-Lorraine, the bearer of many distinctions in geology and its allied sciences, laureate of the Académie des Sciences, member of l'Institut and Chevalier de la Legion d'Honneur.

Thirty-five years ago on his return from a visit to France, J. Peter Lesley, a member of this academy, wrote enthusiastically of meeting in Paris, along with Hébert and other men of distinction in science, a young man whom he characterized as "one of the best of the younger geologists—de Margerie." It is quite safe to say to-night that de Margerie still holds title to that characterization subject to some such modification as the best of the younger looking geologists. At all events the thirty-five years have yielded up their harvest and while we respect and honor him for his versatile accomplishments in many fields of investigation, his researches on the dislocations of the earth's crust, on the interpretations of terrestrial relief in terms of earth structure, his extensive and incessant labors on geological cartography, his bathymetric survey of the oceans, his contributions to the geological map of the world, his orogenic studies in the Pyrenees and the Corbières and the Jura—all these are his monuments—but no devotee of this science of geology can fail to recall without emotion de Margerie's most excellent service in translating from exceedingly difficult and intricate German into lucid French and in illuminating this translation with annotations as important as the original work, Suess's "Das Antlitz der Erde," de Margerie's "La Face de la Terre." To this monumental task de Margerie devoted the years from 1894 to 1917. Scrupulously exact in translation, vastly enriching the labors of that master of geological science, de Margerie has given an impulse to the work which has enabled it to penetrate deep into the present thought of the science. It is a rare good fortune for us that our laureate is here, even though he faces homeward after his cycle of our universities and it is with gratification that your committee introduce him for this award.

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[5] Pritchett, H. S., Report of President of Carnegie Foundation, 1921.

[6] Pearl, Raymond, "Trends of modern biology," SCIENCE, Vol. LVI, No. 1456.

After receiving the medal M. de Margerie replied:

My first word in acknowledging the award of the Mary Clark Thompson Medal must be a word of gratitude.

To be selected as a characteristic representative of the trend of geological research at the present time is a very great honor indeed, specially when one recalls the first to receive that signal distinction Dr. C. D. Walcott, our most distinguished president and my friend for many years.

One of the pleasantest days I can recollect in my whole life occurred just four years ago, in 1919, when, as an officer of the Geological Society of France, it became my duty to report on the work of Dr. Walcott, to whom our greatest prize for paleontology and geology, the Gaudry Medal, had been awarded. I felt even more delighted than I could tell to embrace that unique opportunity of summarizing, for the benefit of my colleagues, the splendid contribution to early Paleozoic structural and organic history which have made the name of the present secretary of the Smithsonian Institution famous throughout the world.

How unworthy do I feel when I see on the rolls of the academy my own name following the name of that great investigator, whose services in deciphering the most complicated problems of Cambrian stratigraphy stand in such preeminence—not to speak of so many other achievements, both scientific and administrative, made in the successive capacities of field explorer, of museum curator, of executive officer, and above all, of invertebrate paleontologist!

It is, I believe, the practice on such occasions as this to say a few words regarding one's own personal experience. Autobiography is a very dangerous type of literature, particularly in its oral, improvised form; and I shall not dwell upon the external events of my life, which—just as for happy nations—have been few and unimportant. Allow me only to refer briefly to some incidents in my intellectual history, which are closely connected with the results for which I am standing here to-night.

First among my feelings comes the joy of work and of discovery. The stimulus of getting at something new, even in a very restricted field, of penetrating a little deeper in the knowledge of nature, has always appeared to me as one of the reasons of living and one of the justifications of effort.

But the true, perhaps, would seem unattractive if it were not constantly associated with the beautiful. And is not the geologist specially fortunate in deciphering, as in a laboratory of his own, sea-cliffs and canyons, great mountain-ranges and glacier-sculptured peaks, burning volcanos or silent caverns? To my mind science seems as inseparable from art; think only of Leonardo, or, nearer to us, of Ruskin, and again, in our own days, of that man of genius, but so modest that very few know of him, William Henry Holmes!

Another factor in science, the importance of which I would like specially to emphasize, is the element of sympathy—the moral or social element. Every bit of scientific work is the product of human effort, the final outcome of a far-reaching chain of inheritance, combined with some data of personal discovery; it occupies a definite place in the intellectual evolution of mankind—and there lies the reason why the history of science, so ably advocated in this country by Dr. Sarton and more particularly on its geological side by Dr. Merrill, is of such importance to develop a deeper comprehension of the past and a surer construction of the future.

Now, to speak again of myself, I have to admit that anything of value which may have come from my pen, in geology and geography, was largely obtained through association with one friend or another. The two first volumes on which my name appeared in print and which were both published in 1888—*Les Dislocations de l'Ecorce terrestre* and *Les Formes du Terrain*—were written in conjunction with my revered masters, Professor Albert Heim, of Zürich, and General de La Noë, of Paris. And, in the preparation of the work which has absorbed more than half of my time since I became interested in geology—the French edition of Eduard Suess's masterpiece: "The Face of the Earth"—I enjoyed the efficient help of twelve among the most active of French geologists and geographers.

Finally, when I was obliged to act alone, may I state that I have always had before my eyes the desire to do full justice to my predecessors in the very field where I was working? The perhaps too bulky volume on the "Structure of the Jura Mountains," which has just been published by the Geological Survey of France, and which is only the introduction to a monograph of a more original character, is, in fact, a continuous appeal to the rights of writers of past generations to get our full esteem for what they achieved, often under very unfavorable circumstances.

I fear I have expanded perhaps too much on my own psychology; and, still, I feel compelled to add something more: the great inspiration I have found, since more than forty years, in perusing the magnificent documents with which America has enriched, during that time, geological science in all its various branches. Never shall I forget the deep impression which some of your great men made upon my youthful mind when I first met them in Paris in the year 1878, on the occasion of the inaugural meeting of the International Congress of Geologists. Again, in 1891, at the fifth session of the same body, what a joy it was for me to greet so many eminent teachers and to exchange ideas with such men as James Hall, Dana, Emmons, Gilbert, King, Lesley, Newberry, Powell, Shaler, Whitney, the two Williamses and many others who, alas, have now passed away, but who have still left to us here the benefit of their wide learning!

To conclude, let me tell you how proud I feel to have received as an acknowledgement of my life-work this beautiful medal; let me thank you for your generosity which I am sure, will be felt very deeply by my colleagues in the French Academy and by French scientists at large; and—last, but not least—let me express my very cordial gratitude and affection to Dr. Clarke for his kind and sympathetic appreciation of my humble efforts.

SCIENTIFIC EVENTS

EDWARD WILLIAMS MORLEY

The following resolutions were passed at the New Haven meeting of the American Chemical Society in memory of Edward Williams Morley, an honorary member of the society:

The American Chemical Society in this memorial wishes to express its appreciation of the great loss it has sustained by the death of Professor Edward W. Morley, who was to have been the honorary chairman of this meeting.

Born in 1838, graduated from Williams College in 1860, he entered the Congregational ministry and was called from it to be professor of natural history and chemistry in Western Reserve College in 1869. He was actively connected with this institution for 37 years and since his retirement has made his home near Hartford, Connecticut, in which city he died on February 24 of this year, shortly after his eighty-fifth birthday.

Although Western Reserve College was but little known at that time, Professor Morley soon brought it into prominence and raised himself by his own genius to be one of the foremost scientists of his time. He was as much a physicist as a chemist, and most of his published papers, curiously enough, lie in the domain of physics, although he allied himself primarily with the chemists.

With remarkable characteristics for precision and thoroughness, he possessed also an unusually clear and resourceful mind and a wonderful mechanical skill, so that he was not only a great investigator, but also an inventor of many new devices for fine and exact measurement. Among these were a precision eudiometer for the rapid determination of oxygen, two types of differential manometers, by which differences of gaseous pressure can be measured to the 1/10000 mm. of mercury and many mechanical features of a minor sort used in the manipulation of gases. Together with Professor Michelson he developed the interferometer, an apparatus for measuring lengths in terms of the wave-length of light, and employed it in measuring the expansion of metals, the relative motion of the earth and the ether, and the velocity of light in a magnetic field.

The work, however, for which he is best known among chemists is that on the densities of oxygen and hydrogen and the ratio in which they combine, published as Smithsonian Contribution to Knowledge, No. 980. This research, finished in 1895 and on which he was engaged for eleven years, brought him world-wide recognition as a scientist of the first rank.

Professor Morley was of a very modest and retiring nature, never pushing himself forward, and for this reason he was not known intimately to many. But those few who enjoyed the privilege of knowing him well were impressed by the sweetness of his nature, the broadness of his culture and knowledge, the nobleness of his spirit and the wisdom of his counsel.

By making him its president in 1899 and electing him to honorary membership in 1900 this society honored not so much him as itself.

REGISTRATION IN GERMAN UNIVERSITIES

Foreign exchanges publish particulars as to the number of students in German universities. The total number had increased to 60,000 at the outbreak of war. At the end of the war the number was 90,000, and in the summer of 1921 it was 87,147. At present it is 82,668. The Technischen Hochschulen had 12,000 students before the war, in 1920 they had 22,976, and last winter 25,556. The division into faculties has undergone changes; the warnings of overcrowding in some faculties have had some effect, but the stream of students has been diverted into other faculties, which are also now hopelessly overcrowded. The following comparison is given with pre-war conditions:

Faculty	1914	1922
Evangelical theology	4,370	2,974
Catholic theology	2,050	1,795
Legal science	9,840	16,834
Medicine	16,048	15,110
Dentistry	976	4,167
Philosophy and philology	14,400	12,823
Mathematics and natural sciences	8,132	9,257
Pharmacy	1,100	1,112
National economy	3,836	17,714
Forestry	....	490

The following refer to technical students:

Faculty	1914	1922
Architecture	2,193	1,811
Constructional engineering	2,767	3,311
Mechanical engineering	3,118	8,306
Electrotechnics	1,307	5,129
Mathematics and natural sciences	1,544	3,785
Mining and metallurgy	576	1,234
Naval engineering	234	365
General	493	1,483

It is stated that the present day student does not tend to the same extent as before the war to study in the large cities.

THE KENTUCKY ACADEMY OF SCIENCE

Dr. Willard Rouse Jillson, director and state geologist of the Kentucky Geological Survey, was elected president of the Kentucky Academy of Science at its tenth annual meeting, which was held at the University of Kentucky on May 12. Dr. Austin R. Middleton, of the University of Louisville, was elected vice-president; Dr. Alfred M. Peter, of the Kentucky Agricultural Experiment Station, secretary, and Professor W. S. Anderson, of the University of Kentucky, treasurer.

The academy voted the authority to its president to make arrangements for the publication of its transactions, which up to the present have never been printed. It also voted to sustain the recent resolutions of the council of the American Association for the Advancement of Science with respect to the facts of organic evolution and the freedom of teaching it and science generally in the public schools. Resolutions covering these points were drafted and approved, and have been forwarded to the secretary of the American Association for the Advancement of Science.

Dr. Jillson outlined a proposed symposium on "Evolution" to be presented during the year as an educational feature under the auspices of the Kentucky Academy of Science in the city of Louisville, and this proposal was heartily endorsed by a unanimous vote. Preparations are now under way for this special meeting, which will be open to the public, and will be held in Louisville probably during the spring of 1924. The regular meeting of the Kentucky Academy of Science for the presentation of scientific papers and the transaction of business will be held at about the usual time in Lexington.

APPOINTMENTS AT THE BUREAU OF MINES

During the absence in Europe of George S. Rice, chief mining engineer of the Bureau of Mines, and until further notice, James W. Paul will be acting chief mining engineer, with headquarters at Washington.

C. A. Herbert is detailed to Pittsburgh to serve as acting chief coal mining engineer, beginning on June 1 for a period of five months, and will report through the superintendent of the Pittsburgh Station to Mr. Paul. He will have immediate charge of the experimental mine work and other coal-mining investigations, except the coal waste inquiry for the United States Coal Commission, which work will be handled directly by Mr. Paul.

M. van Siclen, assistant to the chief mining engineer, will continue in that position and act as executive officer for the mining division, consulting on technical matters with the acting chief mining engineer. He will also act in the capacity of district mining supervisor in leasing matters, except petroleum on Indian lands, and will maintain contact with the commissioner on Indian affairs on all Indian mineral leasing matters, consulting with H. I. Smith on coal-leasing technical matters.

H. I. Smith will continue as mining supervisor and will report through the assistant to the chief mining engineer on administrative matters, consulting with the acting chief mining engineer on technical matters.

S. P. Howell, after July 1, will be detailed to the field investigation of liquid oxygen explosives under the new appropriation. J. E. Crawshaw will continue to serve as acting head of the explosives section and report through the superintendent of the Pittsburgh Station to the office of the chief mining engineer.

FOREIGN MEMBERS OF THE WASHINGTON ACADEMY OF SCIENCES

The board of managers of the Washington Academy of Sciences has elected the following scientific men to honorary foreign membership in recognition of their prominence in their respective fields and their intimate connection with scientific work in Washington:

Professor Leon Manouvrier, Ecole d'Anthropologie, Paris, in recognition of his life-long work in anthropology.

Dr. Carl Frederik Albert Christensen, director of Universitets Botaniske Museum, Copenhagen, in recognition of his services to systematic botany, particularly his monographic studies of tropical American ferns.

Dr. Paul Marchal, Ministry of Agriculture of France, in recognition of his investigations in biological problems and their relation to agriculture, especially for work in polyembryony.

Mr. Edward Clayton Andrews, government geologist of New South Wales, in recognition of his work in geology, particularly in the fields of origin of coral reefs, physiography, origin of the Australian flora, mountain formation and origin of metalliferous deposits.

Sir Ernest Rutherford, director of the Cavendish Laboratory, University of Cambridge, in recognition of his work in physics.

F. Omori, professor of seismology, University of Tokyo, in recognition of his work in the field of seismology.

Professor Guiseppi Stefanini, Instituto di Studi Superiori, Pizza San Marco, Florence, in recognition of his investigations in paleontology and stratigraphy, especially the tertiary formations of Italy and echinoids in general.

Professor Max Weber, University of Amsterdam, in recognition of his work in zoology.

SCIENTIFIC NOTES AND NEWS

Arthur Gordon Webster, since 1892 professor of physics in Clark University, died by suicide on May 15, at the age of fifty-nine years.

Mr. Alva Johnston has received the $1,000 Pulitzer prize of the School of Journalism of Columbia University for the best example of a reporter's work during the year for his reports of the meeting of the American Association for the Advancement of Science, published in the New York *Times* from December 27 to 30.

Dr. Frederick P. Gay, professor of bacteriology in the University of California and at present chairman of the Division of Medical Sciences of the National Research Council, has received from the Belgian Ambassador, on behalf of King Albert, the decoration of Commander of the Order of the Crown in recognition of his scientific work.

Dr. Emmanuel de Margerie, French exchange professor to the United States, was given a farewell luncheon by the American engineering profession at the Harvard Club on May 18, at which several hundred engineers were present. Dr. Albert R. Ledoux, past president of the American Institute of Mining and Metallurgical Engineers, presided.

At the annual meeting of the Association of American Physicians at Atlantic City, N. J., May 1-3, the following officers were elected: *President,* Dr. Charles F. Martin, Montreal; *vice-president,* Dr. Lewis A. Conner, New York; *secretary,* Dr. Thomas McCrae, Philadelphia, and *treasurer,* Dr. Joseph A. Capps, Chicago.

At the annual congress of the Ophthalmological Society of the United Kingdom, held in London at the headquarters of the Royal Society of Medicine, April 26 to 28, Dr. George E. de Schweinitz, president of the American Medical Association, delivered the Bowman Lecture on "Certain ocular aspects of pituitary body disorders." Dr. de Schweinitz was elected an honorary member of the society.

Professor Arthur H. Blanchard, head of the highway engineering department of the University of Michigan, was re-elected president of the National Highway Traffic Association at the final session of the annual convention on May 10.

Dr. Frederick F. Russell, formerly director of the International Health Board's public health laboratory service, has been appointed general director of the International Health Board to succeed Dr. Wickliffe Rose, who resigned to accept the presidency of the newly incorporated International Education Board, and of the General Education Board. The latter office became vacant by the retirement of Dr. Wallace Buttrick, who became chairman of the General Education Board.

Dr. Lewis W. Hackett, associate regional director of the International Health Board, Rockefeller Foundation, has been transferred from Brazil to Italy, with headquarters in Rome. He will sail for Europe in December.

Dr. August Hund has been appointed electrical engineer in the radio section of the Bureau of Standards. He is a graduate of the Technische Hochschule, Karlsruhe, and has been working in the graduate department of the University of California.

Merrill A. Youtz, formerly of the Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology, Cambridge, Mass., has accepted a position in the research laboratory of the Standard Oil Co., Whiting, Ind.

G. F. Moulton has resigned his position at the Bureau of Standards to accept a place as chemist in the research department of F. C. Huyck & Sons, Albany, N. Y.

Dr. Paul M. Giesy has been made director of the Brooklyn Research Laboratories of E. R. Squibb and Sons, manufacturers of chemicals and medicinal products.

The Biological Survey of the United States Department of Agriculture has arranged with the Navy Department for transportation for a party of scientific men who will make a general survey during the spring and summer of the plant and animal life of the chain of islands extending from Niihau in the Hawaiian group to Midway and Wake. Dr. Alexander Wetmore, of the Biological Survey, will have general direction of the scientific activities of the expedition, which will be carried on in part by members of the staff of the Bishop Museum, Honolulu. Donald R. Dickey of Pasadena will accompany the party to secure moving pictures of the colonies of sea birds on Laysan Island.

Dr. Ellinor H. Behre, assistant professor of zoology at the Louisiana State University, has returned from a three months' trip across the northern end of Panama. She devoted herself largely to the study of fishes, collecting live specimens of the poecilidaes for breeding experiments and a series of specimens to indicate the nature of the fauna.

Dr. John W. Harshberger, of the botanical department of the University of Pennsylvania, will sail for Europe early in June to carry on research work in botany. He will join the International Phytogeographic Excursion through the Swiss Alps in July and August.

Dr. A. S. Hitchcock, accompanied by his wife, left in May for South America, where he will make botanical collections. Three months will be spent in Ecuador, the work being a continuation of the cooperation between the United States Department of Agriculture, the Gray Herbarium and the New York Botanical Garden in studying the botany of northern South America. About three months will be spent in Peru and Bolivia studying grasses for the Department of Agriculture.

Dr. E. P. Felt, New York state entomologist, has been given a year's leave of absence for special work for the State Conservation Commission in connection with the campaign against the European corn borer.

Professor Horace G. Byers, head of the Department of Chemistry, Cooper Union, and president of The American Institute of Chemistry, sailed May 8 for a three to four months' trip to Belgium, Germany and France. The greater part of Dr. Byers's time will be spent on investigating the status of the chemical industry in Belgium and France.

DR. FREDERICK L. HOFFMAN, consulting statistician of the Prudential Insurance Company, expects to participate in the meetings of the American Medical Association and the efforts which are being made by the American Society for the Control of Cancer to arouse more public interest in the question of cancer control on the Pacific Coast. Dr. Hoffman on his return will revisit the Navaho and Zuni Reservations of New Mexico and Arizona to continue his investigations which include the measurement of some 1,600 Indians and mixed bloods.

THE May meetings of the University of Pennsylvania Chapter of Sigma Xi was held on the sixteenth of the month at The Wistar Institute of Anatomy and Biology. Professor H. H. Donaldson outlined the work of the institute; Professor Helen D. King spoke on "Domestication," and Professor F. S. Hammett on "Sensitivity and adaptability of the albino rat."

DR. EDWARD L. NICHOLS, professor emeritus of physics in Cornell University, lectured before the Sigma Xi Club and the Scientific Society of West Virginia University on May 10. His subject was "Incandescent oxides."

THE Pennsylvania State College Branch of the American Association for the Advancement of Science held a dinner meeting at the University Club on May 24. Following the dinner Dr. Herman L. Fairchild, emeritus professor of geology at the University of Rochester, spoke on the subject "Glacial history of the Susquehanna Valley."

DR. S. J. HOLMES, professor of zoology in the University of California, gave the annual Phi Beta Kappa address before the California Chapter on May 15.

PROFESSOR T. WINGATE TODD, of Western Reserve University, delivered on April 28 an address before The Royal Canadian Institute on "Royal mummies."

DR. R. M. WILSON, superintendent of the Kwangjer Leper Hospital, Korea, spoke at Washington University School of Medicine on May 9 on the development of the hospital from a few mud huts to its present well-equipped and organized state. Practically all this work has been done by the leper patients. Dr. Wilson has been treating the lepers with Chaulmoogra Oil, recently discovered to be of benefit in this condition. He reports that he has been able to discharge a considerable number of patients as cured, and many others have been greatly benefitted.

A TABLET to Alexander Wilson, American ornithologist, was unveiled at the Academy of Natural Sciences, Philadelphia, May 17. It was designed by Dr. R. Tait McKenzie and presented to the academy by the St. Andrews Society of Philadelphia, through the generosity of the late Dr. F. Lawson Cameron. Alexander Wilson was born in Paisley, Scotland, July 6, 1766, and died in Philadelphia, August 23, 1813.

LOUIS DERR, professor of physics at the Massachusetts Institute of Technology, has died in Boston at the age of fifty-one years.

THE Ohio State Archeological Museum has been made the recipient of the entire collection of Dr. G. Frederick Wright, glacial geologist, which has been gathered from all parts of the world. Dr. Wright was president of the Ohio Archeological and Historical Society for 10 years and president emeritus for two years until his death, in 1921.

THE Steward Observatory of the University of Arizona was dedicated on April 23 on the day of the inauguration of Dr. C. F. Marvin as president of the university. The program included addresses by Dr. Vesto Melvin Slipher, director of the Lowell Observatory; Dr. Robert Grant Aitken, of the Lick Observatory, and Dr. Andrew Elliott Douglass, director of the Steward Observatory.

THE results of the efforts to raise $250,000 among the members of the New York Academy of Medicine for the purchase of a site for a new building were announced by Dr. George David Stewart at the stated meeting of the Academy on May 3. The total amount subscribed up to that time by fellows and associate members was $317,711. The total percentage of resident active fellows subscribing is 90 per cent., the total percentage of all classes of members who have contributed is 82 per cent. The success of the academy in securing this fund assures it of the contingent fund of $1,000,000 from the Rockefeller Foundation and a similar amount from the Carnegie Foundation for the building and for endowment.

THE Astronomer Royal of Great Britain, Sir Frank Watson Dyson, has informed the Harvard College Observatory by cablegram of the discovery of a nova, or new star, on May 8 by Anderson. The initials of the discoverer are not given in the cablegram, but it is presumed that he is the Rev. T. D. Anderson, an English clergyman and amateur astronomer. The new star was situated in the constellation Cygnus, and was of the fifth magnitude, or in other words just about bright enough to be seen with the naked eye under very favorable conditions. The cablegram was relayed to Harvard by the Bureau of Astronomical Telegrams at Copenhagen, Denmark.

THE attention of entomologists throughout the world is called to the fact that, beginning with the volume for 1922, the preparation of the "Insecta" part of the *Zoological Record* is being undertaken by the Imperial Bureau of Entomology. In order that the *Record* may be as complete as it is possible to make it, all authors of entomological papers, especially of systematic ones, are requested to send separata of their papers to the bureau. These are particularly desired in cases where the original journal is one that is not primarily devoted to entomology. All separata should be addressed to the assistant director, Imperial Bureau of Entomology, 41 Queen's Gate, London, S. W. 7, England.

THE secretary of the General Post Office of Great Britain announces that for the purpose of carrying out the scheme by which, in conjunction with the Air Ministry, daily weather reports are to be distributed all over the country by means of the telephone exchanges, England, Scotland and Wales have been divided into some forty districts. Each exchange will thus have available for subscribers information that will be appropriate to the area in which the exchange is situated. It will only be necessary for telephone subscribers to ring up the operator at the local exchange at or after 5 p. m. to obtain the forecast for the following day. No charge will be made beyond the local call fee, and in the case of rural party lines subscribers no fee is payable. The forecast may be obtained also by ringing up from public call offices upon payment of the ordinary local call office fee.

STATISTICS published in the *Journal Officiel* show that the number of births in France in 1922 was 759,846 and the number of deaths 689,267, being an excess of births over deaths of 70,579. The excess of births in 1921 was 117,023 and in 1920 159,790, but the figures for the last year compare favorably with those of 1913, when the number of births was 790,355 and the number of deaths 731,441, being an excess of births over deaths of only 58,914. The number of marriages in 1922 was 383,220, against 456,221 in 1921, 623,869 in 1920, and 312,036 in 1913.

THE Royal Academy of Sciences of Amsterdam has recently prepared a series of papers (in English) summarizing the development of various fields of science in the East Indies, one of which is "A review of chemical investigations in the Dutch East Indies." This is a brief and comprehensive digest of the contributions which have been made by Dutch chemists of the East Indies upon problems of pharmaceutical, agricultural and industrial chemistry of that region. Special mention is made of cinchona cultivation, the sugar industry, rubber, tea, coffee and tobacco cultivation, the production of essential oils and phytochemical investigations. A supply of these papers has been sent to the National Research Council. Copies may be obtained (without charge) by addressing Dr. E. W. Washburn, chairman, Division of Chemistry and Chemical Technology, National Research Council, 1,701 Massachusetts Avenue, Washington, D. C.

ADDITIONS have been made to the zoological museums of the University of Iowa through the courtesy of two alumni, Alfred H. Bailey, curator of birds and mammals in the Colorado Museum of Natural History, Denver, Col., and Clarence J. Albrecht, curator of zoological exhibits at the University of Washington. Numerous birds and some animal skins comprise the new collections which were presented first to Professor Homer R. Dill, director of the vertebrate museum at the University of Iowa, who in turn presented them to the university.

THE British Medical Research Council has undertaken to organize an investigation into dogs' distemper, towards which funds will be provided by the *Field* Distemper Council. Researches will be conducted by members of the Medical Research Council's staff, partly at the National Institute for Medical Research, Hampstead, but more particularly at the new farm laboratory, for which a site near London has recently been acquired. As opportunities arise and suitable assistance can be secured, inquiries coordinated with these will be promoted at other centers of work. These investigations will also be brought into relation with other studies in human and animal pathology. The Medical Research Council has appointed the following scientific committee to advise on the subject and to direct the investigations: Sir William B. Leishman, K.C.M.G., C.B., F.R.S., director of pathology, War Office, and a member of the Medical Research Council (chairman); Mr. J. B. Buxton; Captain S. R. Douglas, F.R.S., National Institute for Medical Research; Professor F. Hobday, and Dr. C. J. Martin, F.R.S., director of the Lister Institute.

IT is reported that the appropriation bill for the Pennsylvania State College covering the years 1924 and 1925 now before the Pennsylvania legislature allows only $1,360,000 for general college operation, a sum over half a million below what is now required for maintenance. It is said that the college can not stand this cut and perform the work it is now doing. In part, a reduction on this scale would mean that: There would have to be a thirty per cent. reduction in a student body of 3,300 men and women; practically no new students could be admitted for two years; the college would face a possible disruption of organization through the loss of valued faculty members; no new research demanded by the people of the commonwealth could be undertaken and present investigations might have to be abandoned entirely; no expansion of work could be considered. Farmers have but recently asked for a new department of agricultural economics at State College, but this could not be established with the maintenance figure proposed.

UNIVERSITY AND EDUCATIONAL NOTES

THE State Legislature of Kansas has appropriated $2,215,288, exclusive of the Smith-Lever offset funds, for the support of the college and station during the biennium beginning July 1. This amount is about $500,000 less than the appropriation made in 1921, the reduction resulting chiefly from the diminished requests by the college for new buildings. The appropriations for salaries and maintenance, from which most of the state funds for the support of the main station are allotted, were slightly increased. The funds for the four substations were increased from $66,000 to $95,288.

A COMPETITIVE scholarship of $1,000 has been offered by the Harvard Engineering School for the year 1923-24, to be open to seniors graduating next month from colleges or departments of liberal arts throughout the country. No student now in Harvard will be eligible for the competitions nor any student registered in any engineering or technical school. Award of the scholarship will be based on the complete academic record of the applicant, together with the result of a special three-hour written examination including mathematics and physics.

DR. LEONARD B. LOEB has been appointed assistant professor of physics in the University of California. Dr. Loeb was assistant to Sir Ernest Rutherford in the University of Manchester in 1919, and for the past four years has been national research fellow in physics. During that period he has worked at the University of Chicago and has published a number of papers on ionization in gases.

AT Harvard University Dr. Esper S. Larsen, Jr., of the U. S. Geological Survey, has been appointed professor of petrography to fill the vacancy caused by the retirement of Professor John Eliot Wolff. Dr. Kirtley Fletcher Mather, now head of the geological department of Denison University, Granville, Ohio, has been appointed professor of geology for a term of one year. Dr. John H. Mueller, now associate professor at Columbia University, has been appointed assistant professor of bacteriology and immunology in the medical school. Dr. E. L. Chaffee has been promoted from an assistant professorship in the department of physics to an associate professorship. Dr. Hilding Berglund, research assistant, has been appointed assistant professor of medicine.

DR. OSCAR M. SLOSS has resigned his post at the Children's Hospital, Boston, to become professor of pediatrics in the Cornell University Medical School.

DUE to the continued illness of President Samuel F. Kerfoot, of Hamline University, Dean Henry L. Osborn, professor of biology and geology, has been authorized to assume the responsibilities of president in his absence.

DISCUSSION AND CORRESPONDENCE

THE ENDOWMENT OF SCIENTIFIC RESEARCH

SCIENCE for April 13 contains two timely reflections upon the use of wealth to aid research. One of them laments the taking over of the research functions of the university by wealthy corporations; the other, echoing Dr. Pritchett's pessimistic query—Can wealth be given away to the benefit of the public?—raises a doubt as to the efficacy of large benefactions in aid of scientific research.

If corporate capital is robbing our universities of their best research professors, should not the fact constitute a stimulus for increasing the diminishing supply rather than a cause for deploring the increasing demand? And if it is lamented that great benefactions to scientific research as now administered do not produce the results one would rightly expect, is not that a reason for changing the prevailing modes of administering these great trusts, rather than a ground for discouraging them altogether?

It is idle to maintain that great corporations can exhaust the most interesting fields of modern science; for every new scientific discovery opens up a dozen new problems of scientific research. Moreover, the fact that these corporations with their great capital of wealth and inventive brains are every day providing science with improved tools for research that university resources could never hope to supply is constantly ignored in these Jeremiads.

It is equally idle to maintain that benefactions in the aid of science are in themselves and *per se* fatal to scientific progress. For these benefactions are supposed to be gifts to science, not gifts to persons. If science does not derive benefit from them, it argues that there is something wrong with the method by which they are administered, not with the gifts themselves.

That the prevailing mode of administering great benefactions in the aid of science is not as efficient as it might be may be due to the fact that those who determine the personal recipients of these funds and the particular research problems to which they shall be applied must decide these matters largely from a personal rather than from a scientific point of view. I do not mean to charge favoritism—that this "kissing goes by favor": but no dozen men in the world, scientists or business men, are capable of wisely determining in all cases and under all circumstances the most fruitful application of these great benefactions. If the proposed benefaction is to be limited to some field of research, its application should be determined by the consensus of the majority of the most experienced research scientists in that field, and not upon the special predilections and enthusiasms of one or two of them; if it is to cover the whole field of scientific research it should first be impartially budgeted with regard to the needs of each particular field and then applied in accordance with the consensus of the majority of its most experienced representatives.

We now have special American organizations for research in the cardinal branches of science and a general clearing house for activities of American scientific research as a whole. By using these instrumentalities to determine the application of benefactions to scientific problems we should at least escape from the limitations of small groups of scientific almoners. Even though the results might not prove to be all that could be desired, the plan is well worth trying, especially in view of the fact that it seems already to have worked well on a small scale. Such a plan would at least prevent the frittering away of large resources upon schemes of research that are unwisely planned or prematurely undertaken or imperfectly coordinated with other activities of advancing science. And if it failed it would at least put the responsibility of justifying these expenditures of wealth, where it really belongs, upon American science as a whole.

With such a scheme of apportioning benefactions in the aid of pure science, the commercial utilities of research might safely be left to take care of themselves; for the large majority of the members of our scientific associations are themselves college professors, and would know well enough what scientific problems needed the support of benefaction and what could be wisely left for solution to the selfish interests of commercial organizations.

MARK H. LIDDELL

PURDUE UNIVERSITY

A TEST FOR ECLIPSE PLATES

THE mere fact that photographs taken during a total solar eclipse show a bending of light rays does not, of itself, prove the Einstein theory. Such bending may be due to the Einstein effect, or may be due to one of several perfectly natural causes: refraction of light through the masses of matter surrounding the sun, or abnormal refractions in the atmosphere of the earth. Until the possible effects of these natural causes have been completely eliminated, the observed light deflections during an eclipse cannot be taken as proof of relativity.

The effects of abnormal refraction in the earth's atmosphere may be very similar in character to the so-called Einstein effect. The higher the sun in the heavens at the time of the eclipse, the more nearly will the effects of abnormal refraction approach the Einstein effect. In fact, in the ideal case the two effects (abnormal refraction and Einstein) follow practically the same law. If, at the time of the eclipse, the sun be in the zenith of the observer and the atmosphere be perfectly quiet, then the shadow of the moon would cause a funnel of cool air to form, coolest along the vertical axis of the shadow. A ray of light from a star would, therefore, pass from warmer air to the cooler air of the shadow axis in reaching the photographic plate, and such ray would be refracted, or would show a bending; and the amount of such refraction would depend upon the distance of the star from the axis of the shadow. The law by which the amount of such refraction would decrease with the distance of the star from the center of the shadow would be the same as that for the so-called Einstein effect. A difference in temperature of only a very few degrees between the air at the axis of the shadow and that at the edges would cause a bending of the rays fully as large as that called for by Einstein. This abnormal effect might be larger than and completely mask the ordinary refraction.

There is rather a simple way of testing an eclipse plate for the presence of such abnormal refraction. Such a plate shows not only the images of the stars, but also the image of the moon. Various points on the edge of the moon might be measured in identically the same way as the star images. Such moon measures could be reduced in a manner entirely similar to that used for the stars, applying the same corrections for orientation, scale value, differential refraction, etc. From these measures could thus be obtained the values for various diameters of the moon and such measured diameters could be compared with that calculated from the lunar tables.

Such an operation ought to give a very good check on other measurements on the plates, it ought to show up any plate distortions, instrumental errors or atmospheric abnormal refractions. If the various diameters of the moon, so measured, show no distortion and agree with the calculated value, then this check would be fairly conclusive evidence that any star deflections obtained are caused by some cosmic action, are due to some cause or causes at a distance farther from the earth than the moon. On the other hand, if the moon diameters show distortions, or a value different from the calculated value, it would be good evidence that any other observed deflections are also of terrestrial origin, either instrumental or atmospheric.

On a plate of very long exposure the motion of the moon during the interval might cause complications, but on a plate exposed for only a few seconds such motion ought to be negligible.

Unless this, or a similar test can be made, the possibility that the observed bending of the light rays from the stars may be due to terrestrial causes will always remain, and the eclipse plates, whatever their results, can not be cited as proof of the Einstein theory.

Chas. Lane Poor

December, 1922

CHANGE OF FREQUENCY ON SCATTERING

A. H. Compton in a lately received bulletin of the National Research Council has reported some recent results obtained by him showing an increase in wave length of X-rays on scattering by graphite of the Molybdenum Kα line amounting to .022Å. U. A. Sommerfeld in his recent lectures, and Compton in *Phys. Rev.*, February, 1923, page 207, have shown that from the quantum theory the shift should be independent of the wave length of the primary beam and of magnitude $\Delta\lambda = \frac{2h}{mc} \sin^2 \frac{\theta}{2}$ where θ is the angle between the incident and scattered beam, h is Planck's constant, m the mass of an electron and c the velocity of light. At $\theta = 90°$ the value of $\Delta\lambda$ is .0242 Å.U $= \frac{h}{mc}$. Compton states that according to his "absorption measurements, over the range of primary rays from .7 to .025 Å.U. the wave length of the secondary X-rays at 90° with the incident beam is roughly .03 Å.U. greater than that of the primary beam which excites it."

Such a shift, if it exists in visible light, should be detectable by interference methods. The writer has looked for such a shift with negative results. A Lummer-Gehrcke plate of resolving power 360,000 was used and the scattered beam compared with the direct beam using the green mercury line as well as various helium lines. The scattering substance was a block of paraffin and scattering was observed at nearly 180°, so that the shift should have been about .048 Å.U., while the plate should resolve to .015 Å.

Multiple reflections to the number of 16 at nearly 180° between silvered glass surfaces were also tried. All results were negative.

P. A. Ross

Stanford University

WHAT IS A PLANT?

The discussions which have appeared in Science during the past weeks indicate that botanists are unable to agree as to a definition for a plant. In such a situation a chemist may perhaps be pardoned for offering a suggestion. The presence or absence of chlorophyll is obviously no criterion, for certain plants, *e.g.*, the "Indian pipe," *Monotropa uniflora*, are devoid of pigments. There is, however, one essential *chemical* difference between plants and animals. In *animals* the principal structural material is *protein* or some form of protein, whereas in plants *carbohydrates* predominate. Could not one, therefore, define a plant as "*a living organism whose cell walls consist predominately of carbohydrate materials?*" This would include the bacteria whose cell walls are composed of chitin, a nitrogenous carbohydrate. The fact that chitin forms the shell structure of certain invertebrates, such as the lobster, does not invalidate the definition, for the cell walls of such animals are composed predominately of protein.

R. A. Gortner

University of Minnesota

SCIENTIFIC BOOKS

The Anatomy and Physiology of Capillaries, The Silliman Lectures for 1922 at Yale University, by August Krogh, Ph.D., LL.D., Professor of Zoo-Physiology, Copenhagen University. Yale University Press, 1922.

In the circulation of the blood "the organs of propulsion, distribution and carrying back are all subservient to the function of exchange carried out in the capillaries and though, of course, each of the great organs is absolutely necessary for the functioning of the whole, it will be difficult to challenge the proposition that the capillaries constitute the most essential part of the whole circulatory system." Thus Professor Krogh early in the first lecture of this series emphasizes the broad importance of his topic. It is a conception which looks upon the particular topic, not as an isolated phenomenon, not merely as a "fragment of an animal," but in its bearing and function in the economy of the whole organism. This standpoint is noteworthy for its similarity to that adopted in two other masterpieces of physiological literature contributed by two previous Silliman lecturers. Krogh, like Sherrington in the "Integrative action of the nervous system" and Haldane in "Respiration," recognizes that correlation and regulation are the prime problems of physiology.

The investigations by the author and his pupils, which form the larger part of the subject matter of this book, arose from the problem of the mechanism by which the exchange of substances and especially oxygen is effected between the blood and tissue elements. How is this function regulated, and adapted to the ever-changing needs and coordinated with the multifarious activities of the living body? The answer, which is one of the most beautiful of recent discoveries, is that in such a tissue as muscle there are many times as many capillaries as are ever opened simultaneously to the blood flow during rest; and that now one, now another channel is opened for short periods, to close again as yet others open. This alternation of dilatation and constriction is under a control which is largely local and is clearly dependent upon the needs of the immediately surrounding tissue elements. Only with the passage from rest to the activity of muscular work are all, or nearly all, of the capillary channels dilated. The surface for diffusion of oxygen and other nutriment is thus varied and adapted to the needs of the working muscle fibers. Spreading along and around the capillaries are the contractile elements which Krogh, in generous recognition of the investigator who first saw them, terms Rouget cells.

From the investigations of Krogh and his pupils and the work of others, which is fully reviewed, it is shown that the capillaries are contracted and dilated independently of the arterioles, and thus form a mechanism independent, in large part at least, from the vasomotor mechanism of Claude Bernard and Ludwig. Beside the heart and the vasomotor (*arteriomotor*) mechanism we must recognize a third and no less important factor in the circulation, consisting of the capillariomotor mechanism: a conception which the reviewer urged as necessary years ago (on much less conclusive evidence however) and called the "venopressor" mechanism, but which was then too unorthodox for some authorities.

Many suggestive observations are here reported also on the reactions of capillaries to stimuli on their part in herpes zoster and erythema, and on their behavior under the influence of heat and cold and in reaction to chemical substances, and especially to histamine.

These investigations do not yet solve the problem of functional hyperemia—the cause and mechanism of the dilatation of all the capillaries of a muscle, for instance, when it is working. But they formulate clearly the problem and take a first step towards its solution; for the discovery is reported and established of a special hormone, identical apparently with that in pituitary extract, which exerts, above every other substance tested, a capillary dilating power.

Two lectures are devoted to the topic of the exchange of substances through the capillary wall—a topic of fundamental importance, upon which many keenly conceived and beautifully executed observations are described, together with stimulating new conceptions of the process of intravital diffusion.

In the last lecture the parts played by capillaries in various processes in health and disease are discussed. The topics include the absorption of dissolved substances from the small intestine, the regulation of the aqueous humor of the eye, inflammation—that supreme problem of pathology, circulatory shock—a scarcely less interesting problem for physiology, and finally the formation and reabsorption of edema.

Clear in conception, method and presentation, and beautiful in the technique both of the laboratory and of the printing press, this book is indeed a worthy addition to the scientific classics which have been published as Silliman lectures. It presents investigations already crowned by the Nobel prize.

YANDELL HENDERSON

YALE UNIVERSITY
NEW HAVEN, CONN.

Tobacco and Mental Efficiency. M. V. O'SHEA. Macmillan Company, 1923, pp. xx and 258.

THIS is a general and popularly written report of the outcome of various inquiries supported by the "Committee to Study the Tobacco Problem." It is an unbiased account of the present state of our knowledge concerning the title subject.

The first third of the book gives an interesting survey of the tobacco habits and opinions of prominent men and women, and cites testimonials typical of those received from several hundred distinguished persons, both smokers and non-smokers. The net results are (a) that such reports do not yield reliable information concerning the influence of tobacco; (b) that unexpected numbers and natures of people smoke; (c) that there is a general objection to the juvenile use of tobacco.

A second section of the book reports studies of the correlation between school work and the use of tobacco. Questionnaire returns and statistical studies, which are cited, show that, on the whole, school men agree that smoking and scholarship are incompatible, but the causal relations are obscure. Comparison of scholarship records with smoking proclivities yields a correlation of —.51. Among high school boys examined the smokers were found to be superior in intelligence tests. They thus fail to live up to their possibilities and the teachers put a good share of the blame on tobacco. Of course a correlation does not reveal causality, but it would at least appear from the data that something is operating to disinterest the more intelligent boys in scholarship and to attract them to tobacco.

Realizing the insufficiency of the foregoing data, the author devotes the last third of the book to a survey of the experimental studies of Dr. Clark L. Hull, detailed report of which is promised in a forthcoming monograph. With well-controlled technique, experiments were conducted on eighteen men college students to determine the effect of pipe smoking on twelve different work processes.

On seven of these tasks the average results are so small or so equivocal as to be negative or uncertain. Steadiness, accuracy in cancellation and facility in learning show impairment. Pulse is increased in rate and motor fatigue is lessened (the sign for muscular fatigue average on page 222 should be + instead of —). The net result is loss rather than gain in performance. The book concludes with a judicious summary of conclusions and a fifteen page bibliography of English books and articles. Throughout the book is distributed also a good deal of discussion concerning the possibility of influences not yet experimentally demonstrated.

In common with most studies of drug effects, individual differences are noted and it is time that such idiosyncrasies be more fully analyzed. Drug investigations already reported provide data which suggests very clearly an inverse relation between susceptibility to drugs and general mental competence. If these indications are reliable it is not "people of distinction" and college students, but instead the mediocre and the natively inferior who may best reveal the characteristic direction and nature of drug influences.

H. L. Hollingworth

Columbia University

SPECIAL ARTICLES

ON AN APPARENT EFFECT OF THE SUN'S ELECTRICAL CHARGE ON THE YEARLY VARIATION OF ATMOSPHERIC POTENTIAL GRADIENT

It has long been known that the electrical potential gradient in the atmosphere undergoes an annual variation, being greater in winter than in summer. It seems still to be generally believed that this variation is due to a corresponding variation in electrical charges situated somewhere in the atmosphere, though all attempts to locate these charges have failed. On the other hand, Erman[1] showed in 1803 that all known phenomena of atmospheric electricity could be explained as due to induction by a negatively electrified earth. A similar theory was proposed by Peltier in 1836. In 1874 Sir William Thomson (Lord Kelvin) in his presidential address before the Society of Telegraph Engineers said:[2]

> I do not say too much, then, when I say that the statement that the air is positively electrified has been at all events a subject for ambiguous and contradictory propositions; in fact, what we know by direct observations is that the surface of the earth is negatively electrified, and positive electrification of the air is merely inferential.

And again,

> The result that we obtain every day of fair weather in ordinary observations on atmospheric electricity is precisely the same as if the earth were electrified negatively and the air had no electricity whatever.

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[1] Gilbert's Annalen, xv, 386.

[2] *Soc. Telegraph Eng. Jour.*, Vol. III, p. 12.

The extensive work of Franz Exner has led him to the same conclusion, so that Erman's theory of atmospheric electricity seems at least worthy of careful consideration.

Attention has previously been called by the present writer to his conclusion that the negative charge of the earth is repelled by a similar charge on the sun. This would result in both a diurnal and a seasonal variation of the electrical potential of the earth at any given place. The diurnal variation has now been recorded almost continuously by photographic methods for two and one half years at Palo Alto. The records show that, in general, the day side of the earth is electropositive to the night side.

A similar annual variation would necessarily follow from the interpretation which I have put on these results. In this case, the winter hemisphere of the earth should be electronegative to the summer hemisphere. Assuming the correctness of Erman's interpretation of the atmospheric potential gradient, this gradient should accordingly be greater in winter than in summer, and it should vary in some manner with the altitude of the sun.

Since only that component of the sun's inductive repulsion which acts toward the north or south would displace the earth's charge in these directions, and since this component must vary as the sine of the angle of the sun's declination from the vertical at any given place, it would seem that the diurnal variation of the atmospheric potential gradient at that place should, if undisturbed by other causes, vary approximately as the sine of the angle of solar declination.

It is known that measurements of the potential gradient give everywhere very irregular results. If the potential gradient is due to the induction of the earth's charge it should have a maximum value if the air were a perfect insulator, and would be zero if the air were a conductor. The air is a very good, though, owing to its containing always some free ions, not a perfect insulator. Its conductivity is too small to admit of direct measurement, but it may be computed from the number and mobility of the free ions which are found in it. Since the amount of its ionization varies, the conductivity of the air is likewise variable, and the potential gradient, which should vary in the opposite direction to the conductivity if it is an inductive phenomenon, should also be variable.

In a recent series of balloon measurements of both atmospheric conductivity and potential gradient which were carried to an altitude of about nine kilometers, Wigand[3] found the product of the potential gradient into the conductivity of the air to be nearly a constant at a given elevation, but to fall off with the altitude at the rate of about two per cent. per kilometer.

It is customary to call this product of the potential gradient into the conductivity of the air the "earth-air current." This hypothetical current is very small, amounting to about 1/100,000 ampere over a square mile of the earth, but it is regularly computed at some observatories. Now it is quite possible to give a different interpretation to this quantity. Thus, if the potential gradient varied inversely as the conductivity, the product of these two quantities would be the true potential gradient for some uniform condition of conductivity taken as unity, and it is this true potential gradient which should vary with the sun's declination.

Observatorio Del Ebro, at Tortosa, Spain, publishes tables of the mean monthly values of the earth-air current, and Figure 1 gives a comparison of the mean of these monthly values for the six years, 1914-19, with the monthly values of the sine of the angle of solar declination at Tortosa. The continuous line represents the mean values of the earth-air current, and the dotted line the values of the sines of solar declination for the corresponding months.

On page 715 of Hann's *Lehrbuch der Meteorologie* is given what is said to be the mean yearly variation of the atmospheric potential gradient for the north temperate zone between the parallels of 45° and 50° N. In Figure 2 the mean monthly values given in Hann's table are compared with the monthly sines of the angles of solar declination for latitude 47½° N. Here, as in Figure 1, the continuous line represents the atmospheric potential gradient.

In the southern hemisphere the same law seems to hold, though much less data on potential gradients are available from the southern

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[3] *Ann. d. Phys.,* lxvi, 81; *Phys. Zeitsch.,* xxii, 623.

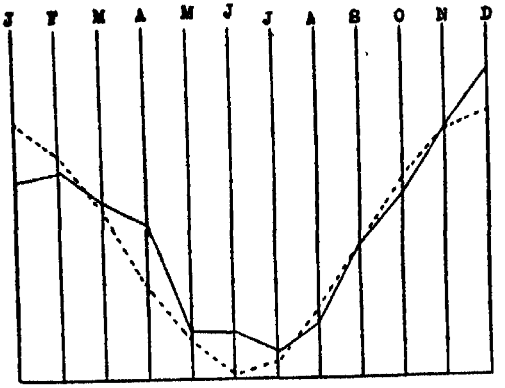

FIGURE 1. Relation of earth-air electric current to sine of angle of solar declination at Tortosa.

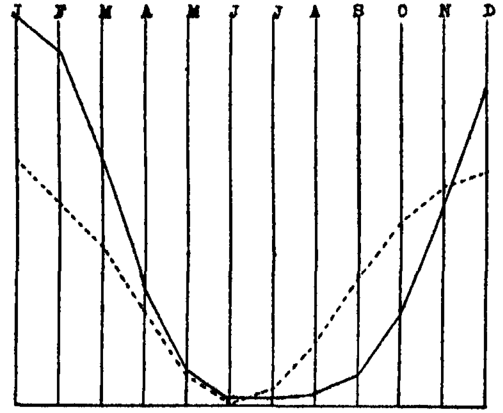

FIGURE 2. Relation of mean monthly atmospheric potential gradient to sine of solar declination for the region between 45° and 50° north latitude.

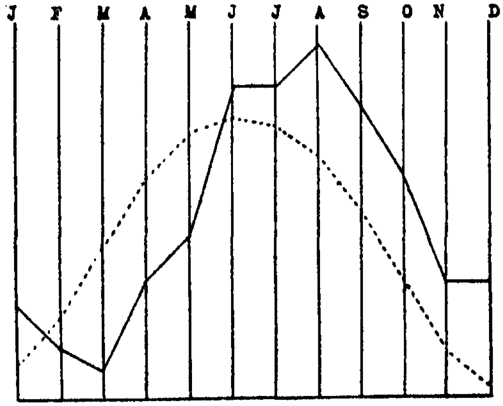

FIGURE 3. Relation of mean monthly potential gradient to sine of solar declination at Melbourne, latitude 37° 50′ south.

than from the northern hemisphere. The monthly potential gradient at Melbourne (Lat. 37° 50′ S.) is given in Hann's *Lehrbuch* and in Arrhenius' *Kosmische Physik,* p. 889. In Figure 3 this data is compared with the corresponding monthly values of the sine of the angle of solar declination for that latitude. The continuous line, as before, represents the atmospheric potential gradient.

In the case of Figure 3 the agreement between the two quantities is not as close as in figures 1 and 2, the data on potential gradient being more irregular than in the other cases. It seems probable that if the conductivity of the air at Melbourne were known, so that the earth-air current could be computed, it would, at least, give a smoother curve.

A more conclusive test of the theory should be given by a station near the Equator, where the curve for the sine of the solar declination must have two maxima and two minima during the year. A case of this kind may be found in the data from Batavia which are given by Hann and Arrhenius. The two curves for Batavia are given in Figure 4, their significance being the same as in the other curves given, the latitude of Batavia being taken as 6° S.

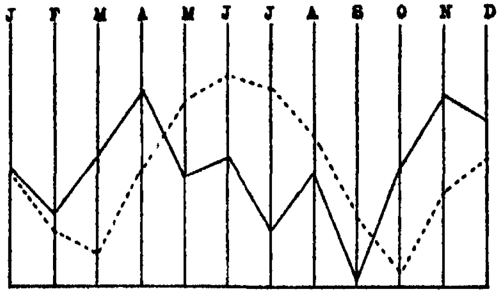

FIGURE 4. Relation of mean monthly atmospheric potential gradient to sine of angle of solar declination at Batavia, latitude 6° S.

The above comparisons seem to the writer to show that the yearly variation of the atmospheric potential gradient, especially when corrected for atmospheric conductivity, is such as would be expected to result from a negatively charged earth under the inductive influence of a similarly electrified sun.

FERNANDO SANFORD.

PALO ALTO, CALIFORNIA,
JANUARY 15, 1923

THE TWENTIETH ANNIVERSARY OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

A PRELIMINARY conference relative to the organization of the Society for Experimental Biology and Medicine took place at the residence of Professor Graham Lusk on January 19, 1903, the first meeting being held in the laboratory of physiological chemistry, College of Physicians and Surgeons, Columbia University, February 25, 1903. The society was founded by the late Dr. Samuel J. Meltzer, who was elected its first president. The object of the society was stated to be the cultivation of the experimental method of investigation in the sciences of animal biology and medicine. There were nineteen charter members and during the first year fourteen additional resident members and twenty-three non-resident members were elected, making a total of fifty-six. At the end of the first ten years the membership had grown to two hundred and fifty-five and numbers at present five hundred and forty-nine. Somewhat less than one third of this number are resident members, the remainder being located in different parts of the United States and Canada and various foreign countries.

The society now possesses four branches formed by groups of members who hold independent meetings, the scientific transactions of which appear in the *Proceedings*. The Pacific Coast Branch was formed in 1912, the Minnesota Branch in October, 1921, the Western New York Branch in February, 1922, and the Peking (China) Branch in December, 1922.

The *Proceedings* of the Society for Experimental Biology and Medicine gives in concise form the papers presented before the society and its branches. It is published monthly from October to May, the current volume numbering about 500 pages. About two years ago, following the death of Dr. Meltzer, members of his family started a fund for the endowment of the *Proceedings*. Through the gift of friends and members of the society this memorial fund now amounts to about $5,500. The society plans to increase this to $10,000.

The one hundred and thirty-first and twentieth annual meeting of the society was held in the biological lecture room of the College of the City of New York at 5 P. M. on April 18, 1923, with an attendance of about 100.

The following papers were presented:

Chemical changes in the blood in intestinal obstruction: J. F. CONNORS, J. A. KILLIAN and H. B. EISBERG.

Metabolism of cystin: G. J. SHIPLE, A. R. ROSE and C. P. SHERWIN.

A micro colorimetric method of estimating the hydrogen ion concentration of the blood: V. C. MYERS, H. W. SCHMITZ and LELA E. BOOHER.

Some studies on the vital staining of the blood cells: R. SPIRIDONOVITCH (by invitation).

Reductional changes in dying protoplasm: ROBERT CHAMBERS.

The influence of nutrition during the pre-experimental period on the development of rickets in rats: ALFRED F. HESS and M. WEINSTOCK.

The various forms of phosphoric acid in the blood. Findings in rickets: T. F. ZUCKER and MARGARET GUTMAN.

Observations on the distribution of antirachitic substances: T. F. ZUCKER and MARION BARNETT.

On the nature of the immunising antigen of pneumococcus: WILLIAM A. PERLZWEIG and GUSTAVE I. STEFFEN (by invitation).

Indican influence by bacillus acidophilus therapy: LILLIAN SEGAL KOPELOFF and NICHOLAS KOPELOFF.

Papers read by title were:

The effect of treatment of rickets in animals and children by the yolk of egg: JOHN HOWLAND and BENJAMIN KRAMER.

Leucocytes in relation to the mechanism of thyroid-accelerated metamorphosis in the larval frog: H. E. JORDAN and C. C. SPEIDEL.

Light as a factor in fish dispersal: F. E. CHIDESTER.

The respiratory exchange of normal and diabetic men following the administration of insulin and epinephrin: RICHARD S. LYMAN, ELIZABETH NICHOLLS and WM. S. MCCANN.

The effect of thyroid products on paramecium: L. L. WOODRUFF and W. W. SWINGLE.

The effect of ultra-violet rays on rats in the circular maze: DAVID I. MACHT and ELMER J. TEAGARDEN, JR.

The occurrence of intranuclear inclusion bodies in certain tissues of the rabbit inoculated directly with the virus of herpes labialis: E. W. GOODPASTURE and OSCAR TEAGUE.

Following the scientific session the annual dinner was held in the faculty dining room of the City College, with an attendance of forty-one members.

Dr. Holmes C. Jackson of the University and Bellevue Hospital Medical College, who has served as secretary-treasurer of the society and managing editor of the *Proceedings* for the past ten years, was elected president to succeed Dr. George B. Wallace. Other officers elected were vice-president, James W. Jobling, Columbia University; secretary-treasurer, Victor C. Myers, New York Post-Graduate Medical School and Hospital; additional member of the council (for 2 years), Stanley R. Benedict, Cornell University Medical College. The term of Eugene F. Du Bois as councilor expires in 1924.

The nominating committee elected for 1924 were A. J. Goldfarb, Graham Lusk, D. D. Van Slyke and G. B. Wallace, resident members; A. J. Carlson, L. B. Mendel and A. N. Richards, non-resident members.

The chairmen of the different branches and *ex-officio* vice-presidents of the society are: Pacific Coast Branch, William Ophüls, Stanford University Medical School; Minnesota Branch, Arthur D. Hirschfelder, University of Minnesota; Western New York Branch, John R. Murlin, University of Rochester; Peking Branch, Carl Ten-Broeck, Peking Union Medical College.

THE AMERICAN MATHEMATICAL SOCIETY

The fifty-first regular meeting of the Chicago Section of the American Mathematical Society, constituting the nineteenth western meeting of the society, was held at the University of Chicago on Friday and Saturday, April 13 and 14. On Friday afternoon, Professor S. Lefschetz, University of Kansas, gave a lecture on "Curves traced on algebraic surfaces." About sixty persons were present at a dinner at the Quadrangle Club on Friday evening. The Section voted to hold its Christmas meeting in Cincinnati in affiliation with the American Association for the Advancement of Science.

The following papers were read at this meeting:

On the representation of a certain fundamental law of probability of Laplace: H. L. Rietz.

An application of areal coordinates to mixtures and the graphical solution of equations: F. E. Wood.

Riemann surfaces and the map problem: H. R. Brahana.

A theorem concerning unit matrices with integral elements: H. R. Brahana.

An application of fractional differentiation to a class of Volterra integral equations: H. T. Davis.

Same left co-set and right co-set multipliers for any given finite group: G. A. Miller.

The linear group modulo p_K: M. M. Feldstein.

Continuous transformations of manifolds: S. Lefschetz.

Certain limitations of the value of the complete independence of a set of postulates: M. H. Ingraham.

Foundation and status of the theory of linear algebras: L. E. Dickson.

General theory of hypercomplex integers: L. E. Dickson.

The optical transformation of surface differentials: Irwin Roman.

Solutions of ordinary differential equations: F. R. Moulton.

On approximation by functions of given continuity: Dunham Jackson.

Vector treatment of the extrema of double integrals: D. C. Kazarinoff.

Cubics associated with a net of conics: F. E. Wood.

An extension of the theory of the double modulus: J. S. Turner.

On certain properties of sets of positive measure: H. Blumberg.

On a class of invariant subgroups of the conformal and projective groups in function space: I. A. Barnett.

The area preserving group in function space: I. A. Barnett.

The papers of Professors Blumberg and Barnett were read by title.

Arnold Dresden
Secretary of the Chicago Section

THE MICHIGAN ACADEMY OF SCIENCE, ARTS AND LETTERS

The twenty-eighth annual meeting of the Michigan Academy of Science, Arts and Letters was held in Ann Arbor March 28-30, 1923. The presidential address was given by R. A. Smith, state geologist of Michigan, on "The land-economic survey of Michigan." At the first general session memorials to the two past-presidents who had died during the year, Leroy H. Harvey and Walter B. Barrows, were presented. At the same meeting a paper, "The length of geological time based on observations within the field of physical geology," was given by H. H. Hobbs. The programs of the scientific sections follow:

SECTION OF ANTHROPOLOGY

The physical culture of the Michigan Indians: W. B. Hinsdale.

An archeological survey of Berrien County, Michigan: Geo. R. Fox.

The human and associated animal remains of the Kentucky Caves: Arthur M. Miller.

Folk-lore of fossils in Greek and Latin: Eugene S. McCartney.

The stone cave temple of Kyungju, Korea: W. Carl Rufus.

Food plants of the Polynesians and their bearing on route and time of migration: Forrest B. H. Brown.

The food prohibitions and guardian spirits of the Exogamous Septs of the Batak: H. H. Bartlett.

SECTION OF BOTANY

The heart-rot of black ash caused by Polyporous hispidus (Fr. with lantern): Dow Vawter Baxter.

Imperfect stages of some higher pyrenomycetes obtained in culture: Lewis E. Wehmeyer.

A native homothallic mucor: Bessie B. Kanouse.

Longevity in spores of Aspergillus Oryzae and Rhizopus Nigricans: Adelia McCrea.

The production of improved strains of Hevea brasiliensis: Carl D. LaRue.

Notes on the failure of seed crop of Hevea brasiliensis on east coast of Sumatra: Carl D. LaRue.

The nuclear-chiaera theory of inheritance in Oenothera: H. H. Bartlett.

The vernacular names of certain Sumatra plants: H. H. Bartlett.

Notes on the orange rust of Rubus: E. A. Bessey.

Native Michigan shrubs for ornamental use: E. Genevieve Gillette.

Observations on the poisonous plants of Michigan: E. F. Woodcock.

Vegetable zones in the Western Himalayas (with lantern): L. A. Kenoyer.

Distribution of umbellales in Michigan: L. A. Kenoyer.

Distribution of ericales in Michigan: L. A. Kenoyer.

Meteorological data, Douglas Lake, Michigan, 1922: F. C. Gates.

Swamp and bog plants: Iris versicolor: F. C. Gates and Elsie E. Erickson.

Annual growth of Pinus resinous and Pinus strobus near Douglas Lake, Michigan: Dorothy J. Cashen.

Notes on Michigan flora, Part VI: O. A. Farwell.

Comparative study of the distribution of the Climax Associations in Southern Michigan: Bert Edwin Quick.

The composition of Climax Plant Associations in Minnesota: H. F. Bergman.

Studies on the buffer action of plant juices: F. G. Gustafson.

Attempts at reversal of geotropic response: Anna Haire.

Further determinations of optimum temperatures for growth: F. C. Newcombe.

Significance of the behavior of sensitive stigmas, II: F. C. Newcombe.

Latex-flow in the Para rubber tree: Carl LaRue.

SECTION OF ECONOMICS

The business cycle and economic stability: E. E. Day.

Some underlying assumptions of mathematical statistics: H. C. Carver.

Discussion: P. D. Cahow, C. H. May.

The automatic theory of imputation revised: F. M. Taylor.

Some aspects of equipment trusts: Kenneth Duncan.

Discussion: G. S. Peterson, I. Leo Sharfman.

Some problems of land utilization in Michigan: C. O. Sauer.

Some phases of the problem of tax incidence: H. C. Caverly.

Discussion: F. A. Bradford.

Factors in the formation of public opinion: L. J. Carr.

Public opinion as a force in international affairs: J. S. Reeves.

Discussion: H. L. Lurie, E. D. Dickinson.

SECTION OF GEOLOGY AND GEOGRAPHY

Michigan's Pleistocene features compared to those of border districts: Frank Leverett.

Michigan iron ore reserves: L. P. Barrett.

The geological significance of areas of unrest of the ocean bottom. Illustrated. William Herbert Hobbs.

The sonic depth-finder as a means of preparing a map of the ocean floors (illustrated): William Herbert Hobbs.

Fossils of the lignitic coal pebbles of the glacial drift at Ann Arbor: H. H. Bartlett.

The presence of cataract strata in Michigan supported by fossil evidence: G. M. Ehlers.

A drill core section of the Salina below the *salt bed of the Detroit Rock Salt Company Mine:* J. W. Vanderbilt.

Recent cave exploration in Kentucky for animal and human remains: Arthur M. Miller.

The cause of color in rose quartz (a preliminary paper): E. F. Holien.

SECTION OF PSYCHOLOGY

A criticism of Freudian psychology: Gilbert L. Brown.

The psychology of motives: Henry F. Adams.

The X and the Y of psychology: Orland O. Norris.

The relative reliability of intelligence tests and students' marks: Nathan A. Harvey.

A critique of present tendencies in mental testing: Ernest B. Skaggs.

SECTION OF SANITARY AND MEDICAL SCIENCE

Complement binding property of normal bovine serum: I. F. Huddleson.

The detection of diabetes: O. A. Brines.

Chemical studies on the saliva: Howard B. Lewis and Helen Updegraff.

The absorption of hippuric and benzoic acids from the intestines of the rabbit: Wendell M. Griffith.

Physiologic changes in certain mental disorders: Theophile Raphael.

Disinfection of public water supplies: W. C. Hirn.

Industrial wastes: E. F. Badger.

Observations on paratyphoid-like organisms recovered from feces: P. C. Yull and Minna Crooks.

School room ventilation: G. T. Palmer.

Non-contact carriers in diphtheria: F. M. Meader.

A statistical study of 18,000 cases of venereal disease: W. J. V. Deacon.

A demonstration of an improved procedure of Kahn's test for syphilis: R. L. Kahn.

Further clinical observations on the Kahn test for syphilis: H. L. Keim.

Dengue in guinea pigs: Harold R. Roehm.

Cultures of leishmania: H. M. Soule.

Gas changes in cultures: F. G. Novy.

Note on the viability of Leptospira icteroides in cultures: P. B. Hadley.

Transmission of Bacillus pyocyaneous: P. B. Hadley.

The lytic action of certain sera: R. W. Pryer.

Bacteriophage acquired through contact with colon typhoid intermediates: H. P. Hoskins, Rhea Barbarin and Francis Klasell.

Some observations on D'Herelle's phenomenon: C. A. Palmerlee.

The D'Herelle's phenomenon from a quantitative standpoint: M. S. Marshall.

SECTION OF ZOOLOGY

The fresh-water molluscan fauna of South America: Bryant Walker.

The reptiles of the Dutch Leeward Islands: A. G. Ruthven.

The new natural history preserve of Hillsdale College: Bertram Barber.

Records of mammal distribution in Michigan: L. R. Dice and N. A. Wood.

The land vertebrate communities of Western Leelanaw County, Michigan, with an annotated list of the mammals of the county: R. T. Hatt.

The snakes of the genus Virginia: Frank N. Blanchard.

A method of rearing tubificidae in the laboratory: Eugene F. Powell.

A method of making dried preparations of earthworms for the demonstrations of their gross structures: George R. LaRue.

The hydrogen ion concentration in the waters of certain Northern Michigan lakes: Paul S. Welch.

The calculation of growth in fishes illustrated in the common sunfish, Eupomitis gibbosus: Charles W. Creaser.

The permeability theory of anesthesia: L. V. Heilbrunn.

Some observations on the feeding of Actinophrys sol: H. T. Folger.

The effect of temperature on dominance: A. D. Hersh.

A new encarsia parasite on the whitefly: A. Franklin Shull.

The habitat of Aphredoderus sayanus in Kalamazoo County, Michigan: Herbert R. Becker.

Methods of determining the date for the control of second generation of codling moth in Michigan: R. H. Pettit.

The fish of Eastern North Dakota: T. L. Hankinson.

A collecting trip to Brazil: Jesse H. Williamson.

The life history of Tetraopes tetrophthalmus Forst: W. J. Clench.

Demonstration of fish scale measuring apparatus: Charles Creaser.

The officers for 1923 are:

President, Campbell Bonner; *secretary-treasurer,* L. R. Dice; *editor,* P. S. Welch; *librarian,* W. W. Bishop; *vice-presidents of sections—Anthropology,* H. H. Bartlett; *botany,* R. P. Hibbard; *economics,* C. E. Griffin; *geology and mineralogy,* Helen Martin; *psychology,* H. F. Adams; *sanitary and medical science,* Philip Hadley; *zoology,* L. R. Dice.

Carl D. LaRue
Secretary

SCIENCE

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THE PLACE OF STATE ACADEMIES OF SCIENCE AMONG SCIENTIFIC ORGANIZATIONS[1]

DURING the early part and the middle of the last century, when the means of transportation were less abundant than at present, when science was not so highly differentiated and scientific men were not so thoroughly organized, the state academies were at the apex of their influence. Those citizens in the most populous centers of the more progressive states that were interested in science banded together to talk about the new books that were being published abroad, to share with each other their various discoveries, to lend each other specimens, to show each other their collections and to discuss in general the scientific news brought to their attention by travellers. They were—most of them—amateurs whose vocations were along business lines and whose pastime was science. The telescope and the microscope were their instruments of pleasure rather than golf sticks, and the objects of their interest were the minute or the distant, rather than their scores. Scientific knowledge was by them regarded as cultural—to be acquired deliberately and to be dispensed with dignity. They were the chosen among the intellectuals. They were possessors of information that was unattainable to the common herd and he who reached the heights of publication became the elect of the elect. New theories were scanned with awesome wonder and new terms were caressed by the tongue as delightful morsels and the more complex they were the more appetizing they became. Discussions of new views were carried on with warmth and sometimes with heat. Often open meetings were held, when the members explained the mysteries of science to the uninitiated in the subject and incidentally acquired fame. As the fashion of speech in those days was oratorical there was much in the explanations that the listeners did not understand, but that contributed all the more to the reputation of the speakers—and they and their confreres in the academy were regarded as the "aristocracy of learning."

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[1] Abstract of address delivered before the Wisconsin Academy of Sciences, Arts and Letters and the Wisconsin Archeological Society, at Beloit, Wisconsin, April 6, 1923.

There were then no professional scientists to commercialize their wisdom, unless we except the few teachers of natural history in the eastern universities and the few government geologists whose travels to and fro among the industrious farmers were looked upon as the wanderings of the unbalanced. The salaries of these men, moreover, were so small that they were never regarded as making their living by science and so were not thought of as following a profession.

The state geologist of North Carolina, for example—the man for whom the loftiest peak in the Appalachians was named—was allowed by the state the munificent sum of $200 for his year's work among the mountains, on condition that he furnish and maintain his own horse. Is it any wonder then that the professional scientist was not regarded as debasing his love for paltry cash! Indeed no scientist in those days exchanged knowledge for money: they were all amateurs in the sense defined by the athletes.

In spite of the fact that the members of the State Academies constituted a caste apart, the societies nevertheless were doing a good work. They were keeping alive the tiny spark of scientific flame that had all but been quenched in the turmoil and stress that attended the making of a nation. There was little time for contemplating nature; most of it was employed in wresting from her the wherewithal to live. Had it not been for the enthusiasts in the academies the populace would have lost all touch with scientific thought.

As the conditions of life became easier and the demand for scientifically trained men arose, the professional scientist developed. At the same time science became more complex and its differentiation into branches followed. Science became technical. It was no longer possible to become familiar with all its ramifications. The demands on the mind were so urgent that few minds were able to accede to those of more than a single branch. The new generation was compelled to specialize. It was not content with the general knowledge of its fathers and as a result the old science groups began to disintegrate. The professional scientists, finding little in the state academies that was thought worthy of their attention, did not fill the places of the older men who were gradually dropping out because of increased age. Thus many of the state academies ceased to function as active bodies. The professional men, as they increased in numbers, formed their own organizations and state academies were neglected. Those that contained a few enthusiasts continued to exist, but rather as social clubs than as scientific groups. Others that had acquired a little collection during their more prosperous days maintained a small museum. A few in the larger states became publishing bodies. But most of them simply became comatose. A few years ago Professor Whitney sent inquiries to all the state academies for the purpose of learning something about their activities. Only twenty-four replied to his questions and of these only eight reported vigorous life; twelve were dormant and four were reported dead.

The question arises, therefore, as to the desirability of maintaining organizations that appear to present so little purpose in their existence. Shall they be allowed to die, or should they be resuscitated with the hope that they may accomplish some work that is not now being undertaken by other agencies?

They can not serve successfully as local technical societies except in the largest states, because their membership is comparatively small and is too divided in interests to furnish groups for discussion and their programs are consequently too dilute to attract many serious students. The interests of science workers are best served by branches of the national societies where there are enough persons of kindred interests to insure free discussion. In some states and in groups of neighboring states we already see the mathematicians and other specialists attending their own meetings and neglecting those of the state academies and with an increase in the density in population this tendency to "flock together" will be intensified. The result of this tendency is that the meetings of the academies are becoming labored, with the younger academicians refusing to contribute to the program because of modesty, since they can not hope to add much to the general store of knowledge, and the older members saving their best efforts for their technical societies. The state academies can not successfully become little "National Societies" for the reason given, nor should they try to do so because that would mean a duplication of work and consequently a waste of energy.

We often hear the wish expressed that the state academies might serve the purpose of bringing together in a single meeting scientists with varied interests to discuss matters of general interest to all scientists. In my own opinion this is impossible. Science is now too specialized to furnish many subjects of general conversation. Though we may earnestly wish to become acquainted with the advanced thought in other branches of science than our own, the wish, it seems to me, is impossible of accomplishment because most men are not furnished with the proper mental digestive apparatus for its assimilation.

If, then, the state academies should not attempt to function as little technical societies, how may they function? Is there any place they can occupy to the benefit of science?

In reply to this question there are several suggestions that offer themselves.

(1) They may serve as agencies to encourage the study of local science, *i.e.*, of science applied to the local problems and for the publication of the results of such study.

There are many subjects of local interest that ought to be studied, if for no other purpose than to be recorded, since conditions are changing rapidly. The facts of common knowledge to-day may be forgotten to-morrow. If it is not some one's business to record them, they may be lost forever. Many valuable observations may be made in one's own neighborhood. If the observer is careful and accurate, observations that appear at the time to be trivial may be of fundamental importance to an investigator who may later be engaged in the study of a general problem. The ecological botanist of to-day would welcome results of a careful study of the native prairie flora that had been made at widely separated places at a time before imported plants had become widely spread. Such a study would furnish him with a standard by which he could measure the rate of spread of an introduced flora, or might enable him to determine the influence of a changed environment upon the original plant assemblage. It would have been a comparatively simple piece of work that would not have been beyond the powers of a comparative novice in botany, but it might have supplied data which can not now be obtained. Again, the continuous observation of the action of a little stream in modifying its channel is not a difficult task, but the results obtained might well be of service in helping to explain the action of a big river and might furnish a hint that would aid us in understanding some of the difficulties in the interpretation of erosion processes.

In other words, the careful study of simple phenomena may, in many cases, contribute to the understanding of much more complex ones and the state academies may well charge themselves with the encouragement of such studies. The field is all around us. But the laborers are comparatively few. They might be increased to almost any extent, for

> On every thorn delightful wisdom grows;
> In every rill a sweet instruction flows.

The state academies will justify themselves if they can originate any plan that will enlarge their number.

Although this objective phase of local science study is highly important, the subjective phase is even more important. The influence of any intensive observational study on the mind of the student sharpens his eyes and brightens his wits. His judgment is matured by comparison of his conclusions with those of others observing similar phenomena. This is education and it is this kind of education that differentiates the science student from the students in many other lines. Without it he is destined to be a failure as a scientist, even though fully equipped with book knowledge; with it he may be efficient even though his book knowledge is scanty. Good observers are needed and the best training for accurate observation is through the exercise of the observing faculty. If the state academies can keep the young observer investigating they will be doing much to supply the state with dependable men and women who can be called upon for service when service of this kind is demanded for the welfare of the community. And the state academies can do a great deal toward this end if they will encourage the young worker to do what he can with the material at hand, will show an appreciation of his attempt to do some little thing in a worth-while way and will welcome his contribution to the general fund of scientific knowledge. If he is accepted as one of the serious workers in his field there will result a reaction in his mind that cannot help but be of benefit to him as a man but also as a scientist.

Perhaps in no other way can the appreciation of a man's work be shown better than by publishing his results. For this reason alone, if for no other, it is important that the academy should publish its proceedings. The appearance of the results of a man's labor in print is in some measure a guerdon of the approbation of his associates—and with the favor of his associates secured, his pride in his work will be increased and his enthusiasm for further work will be assured. Another convert to the religion of work will have been gained.

But the publications of the state academy have another function which they can exercise in such a way as to supplement the activities of the national societies without in the least duplicating effort.

There are many facts of local interest that for their own value are worthy of presentation at meetings of scientific men and many details connected with local scientific discoveries that are worthy of preservation, but which can not be printed in the proceedings of national societies because of lack of space. Some of them at the time of presentation may appear trivial, but trivialities have a habit occasionally of growing into significancies—like the falling apple which Newton is supposed to have noted. An observation may not be profound, but if it is not known to have been made before it is part of wisdom to place it on record. It may fill a gap in a line of reasoning.

Details are often tiresome, but the accumulation of details is necessary to the development of a generalization and the state academy may serve a good purpose to science by placing them also in the record. Thus, by recording facts of local interest and the details of observations, the state academies of science might serve a purpose similar to that served by local historical societies.

On the other hand, it seems desirable to many of us that the practice of printing in the academy transactions lists of species or descriptions of varieties of animals or plants of little interest to any but specialists should be abandoned. It may be of value to know exactly the number and names of the different kinds of moulds that have been discovered on the willows of southern Wisconsin, but the proper place for such a publication is a bulletin of some natural history survey, or perhaps the pages of some technical journal. Not only is it unfair to the members of the academy to expend their contributions on a matter of interest to so few persons, when so many other articles of more general interest are awaiting publication, but it is also unfair to the workers along the line of the publication to encourage the burial of a paper of this type in the midst of a mass of material of such different character. The literature of any branch of science is already so widely scattered that it is a serious undertaking to follow it through all its ramifications. If the academy is to serve science it should discourage every practice that will make more difficult the searching of the literature for highly technical articles and should avoid every tendency to waste the investigator's time. If we could confine the printing of material to the publications in which it is naturally sought, the chances of the scientist to occupy a comfortable berth in the distant future would be greatly increased. It might be well to have it distinctly understood that no paper will be published in the academy proceedings which should not be read before an audience at the general meeting. If the academy succeeds in preventing the appearance on the pages of its proceedings of a valuable article that ought to appear elsewhere it will have done a service to science of no little value.

(2) The state academies may further justify their existence by functioning as educational agencies. The non-scientific citizen gets little accurate knowledge of what science means from the newspapers and little more from the popular magazines. He may become acquainted with

a few facts, but he learns almost nothing of the teachings of science or of its tendencies. The state academies might well attempt to give a sane view of science to the man who is not technically trained and especially to convince him that scientific theories are based on a careful and painstaking search for the truth.

If the majority of the citizens of Oklahoma were convinced that scientific conclusions are not biased and that they are never final, but are constantly being tested as to their correctness, the legislature of the state would never have considered seriously the law forbidding the use in the schools of any text-book suggesting the possible truth of the theory of evolution. If the church membership of Minnesota were a scientifically educated membership its representatives would never have passed the resolutions that gave Van Loon a text from which to write a good-natured comment on their sophistry.

"The histories of H. G. Wells and Hendrik Willem van Loon," say the Minnesota resolutions, "are unworthy of a place in a university class room and unfit for our public schools because they introduce an element of mere speculation as to the origin of man and call it history and use this theory in manifest endeavor to destroy the faith of the students in their creator, God, and their supernatural redeemer."

"Being convinced that such teachings will eventuate in anarchy of government, we citizens urge for immediate assurance that atheistic, rationalistic and materialistic textbooks and teachers shall not be continued in our public schools," etc.

"Everywhere," retorts van Loon in the Baltimore *Sun*, "is the same dispute, based firmly upon ignorance and prejudice.

"Everywhere it is the same story of ill-paid, honest, hard-working scientists threatened with the loss of their livelihood by the illustrious companion of the cat that eats cucumbers and the Seminole saxophone sextet."

It is only by discussion that the truth is made evident. The state academy may perform a great service to the community if it will so arrange its program that a part is annually devoted to a frank statement of the condition of mind of science with reference to some great theory, or some subject of general popular interest. This year the Illinois Academy will devote its entire morning session to a statement of what the "Theory of evolution" is and why it appears to be well founded.

The state academies can do work of this kind better than the technical societies because, being less technical, they can reach a larger audience and, because they always meet in the same general community, they can work the field more thoroughly. Moreover, the speakers at the academy meetings are usually more familiarly known to the citizens of the community than those speaking at the meetings of the national societies. They are fellow citizens whose lives are known to be upright and whose thoughts are known to be normal and who, therefore, are listened to with more sympathy and patience than are the visitors from foreign states, who fill the greater part of the programs at the national society meetings. Moreover, since the audiences at the academy meetings are known to be composed largely of persons who are not technically trained, the speakers are more apt to use in their talks fewer technical terms than is likely to be the case when addressing members of local technical societies. Consequently the state academies occupy a position which, in this respect, is quite different from that of the technical societies and any effort they may exert in educating the public in scientific matters is not a duplication of the efforts of any other agency in the field.

(3) But the state academies may not only serve as educational agencies. They may serve also in a very direct way as training schools for young science teachers and indirectly for their pupils. The academies may by such service greatly advance science.

The future of science depends upon the coming generation and the training of the new generation is entrusted to the young men and women of the present generation. It is important, therefore, that the young teachers be encouraged, not only to impart the proper kind of knowledge to the students under their charge, but also to implant in their minds the means of acquiring new knowledge and to help them to reason on the foundation of facts observed. The teachers should therefore be urged to observe and infer, to experiment and speculate, in order that they may be the better prepared to lead their pupils along the proper paths.

There are many instructors in our colleges, high schools and normal schools who might contribute a mite to the sum total of scientific knowledge if they felt it worth the effort to do so and at the same time might indirectly instil into the mind of some bright student the desire to do likewise. If they can be persuaded to do the work necessary to learn a new fact or to obtain a new point of view the experience accumulated in the effort will be of immense value to them not only as independent investigators but also as interpreters of the results of other investigators. They will become more interesting teachers, because they will speak with a greater understanding of the significance of the statements made in the textbooks and will often be able to illustrate them with references to their own discoveries. The pupils will consequently be apt to feel that they have a wide-awake teacher who is interested in his subject, rather than one whose interest is mainly in his salary. Impressed with the thought that things worth looking into are actually happening in his vicinity and that there are interesting facts to be discovered about objects that hitherto may have seemed commonplace to him, the normal boy or girl, impelled by his natural curiosity, will want to learn about them. Of course, many will soon tire of this kind of exploration, but some will find it fascinating—and a new scientist will be started on his career.

Certainly a teacher who is not himself a student of nature will never inspire his pupils to become scientific workers—and no teacher can possibly be a student of nature who doesn't study his environment.

I believe the most important function of the state academy is to prevent the science graduate who goes into teaching from becoming a penny-in-the-slot machine for retailing little scraps of knowledge recurrently at the ringing of an electric bell. It is our business as members of the academies to do what we can to prevent dry-rot in our science graduates before they make even an attempt at blooming. Of course, we know that most graduates in science have written theses based on research. But we also know that in most cases the impulse that originated the researches and the impetus that kept them going were not products of the writers' cerebration. It should be our business to help the young scientist one step farther by encouraging him to undertake a little piece of work on his own initiative and to carry it through by his own effort. The academy will serve a good purpose if it emphasizes the value of such work by urging the young man or woman to contribute to the program at a general meeting where results of the study may be discussed. If his offering meets with a sympathetic reception and his paper appears in print his self-respect will be increased and his standing in the community will be raised and as a natural reaction his mental processes will become vigorous and he will, in consequence, become a more and more valuable teacher of his science and a far better leader of his students. In order to accomplish this end, I believe it is necessary to assign a large part of the program at the annual meeting to the young scientists. The older ones have their national technical societies in which to make their flights, but the younger ones, who are not in large cities, have no place in which to try their wings unless it is furnished them by the state academies.

But experience teaches that the normal young man or woman will not willingly appear on a program if he feels that most of the papers are to be by seasoned investigators, because of the fear that his contribution will seem too trivial by contrast. Consequently, I repeat, the program must be left largely to the beginners in research. It may be desirable to flavor the program with a few papers by the older men, but it should be distinctly understood that the success of the meeting is mainly in the hands of the younger men. I have confidence that if the young scientists of the state are convinced that the academy meetings are for them, they will accept the responsibility for making them of value and will work earnestly to that end. I believe the most important function of the state academy is to encourage the young science teacher and that if it can do this successfully it will warrant the work and the effort expended in keeping it alive.

This year the Illinois Academy is experimenting to learn whether the views that have been expressed are justified or not. Not only are the young instructors of the preparatory schools and colleges being urged to share largely in the coming meeting, but also the senior students in the colleges. The sectional meetings have been placed under the control of the younger instructors in universities, colleges and high schools and they have been asked to secure as many papers as possible from persons who have never before been on the program. As the result of a vigorous campaign there have already been submitted to the committee on the program the titles of ninety-one papers, of which only twenty-one are offered by university instructors of the higher grades. Men representing state departments of science have offered fourteen papers, college instructors and associates and assistants in the universities twenty-six papers and students and unattached scientists thirteen. The remaining seventeen papers are in the sections devoted to public health, psychology and education in which the contributions must naturally be highly technical.

But we are trying this year to do even more than simply interest young men and women in continuing their scientific training. We are attempting also to encourage the boys and girls of the high schools to employ proper methods in scientific work. We are not yet sure how this may best be done but we are making a start at solving the problem. Our first step was to affiliate with the academy the science clubs already organized in the high schools. Our next step will be to try to organize clubs in those schools in which now no such clubs exist. We are organizing a special section which will be devoted to subjects that appeal to boys and girls of high school age and at the coming meeting in May they will have a section controlled by themselves. The students of Knox and Lombard Colleges and of the high school at Galesburg will act as hosts and the subjects for discussion will be radio, taxidermy, bird study and home chemistry.

The coming annual meeting will not be of the same high technical value as last year's meeting at Rockford, but a much larger number of persons will participate in it—and a much larger share of the papers will be presented by young persons. Most of the articles will be short, but many of them will represent the first attempts at individual work on the part of their authors. The general meetings have been arranged mainly for educational effects. The morning program will comprise three talks on evolution in which the reasons for the acceptance of the doctrine as a working hypothesis will be given in a popular way by a botanist, a zoologist and a paleontologist. The evening program will be a little more technical but it also will be educational in purpose. The morning meeting will be mainly for the public in general and the evening meeting for the academy members and that portion of the public that is scientifically inclined.

It is hoped that the general and scientific meetings between them will accomplish the three functions that seem most natural to a local scientific organization without duplicating any of the activities of the national societies.

W. S. BAYLEY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SAFEGUARDING OF NATIONAL PARKS[1]

WHEREAS, by repeated action by Congress for more than half a century, widely approved by scientific and other societies and by the public generally, the National Parks of the United States have been completely conserved from industrial uses so as to constitute a system of National Museums of Native America, and

WHEREAS, one of the national parks of Canada is similarly completely conserved, and

WHEREAS, the combined National Parks System of both countries, covering geological, biological and geographical examples from the Alaskan Range, through the Canadian Rockies, to the Grand Canyon of Arizona, if preserved untouched, will constitute a unique Continental Exposition of inestimable value to science and to the popular education of future generations; and

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[1] A resolution favoring the complete safeguarding in perpetuity of all national parks in the United States and Canada against every economic or commercial use of whatever kind, adopted in principle by the executive committee of the council of the American Association for the Advancement of Science at the regular fall meeting of the committee, October 21, 1922, and issued from the Washington office of the association, April 25, 1923.

WHEREAS, at the option of a single official of the government, several of the national parks in the United States are nevertheless open to mining and grazing, while the control of water power in future parks has recently been surrendered to the Water Power Commission; and all but one of the national parks in Canada are similarly open to certain economic or commercial uses; and

WHEREAS, this generation can pass on to future generations no greater gift than these parks in their primitive condition. Therefore,

BE IT RESOLVED, That the American Association for the Advancement of Science earnestly requests the people and the Congress of the United States and the people and Parliament of the Dominion of Canada to secure such amendments of existing law and the enactment of such new laws as will give to all units in the international parks system complete conservation alike, and will safeguard them against every industrial use either under private or public control at least until careful study shall justify the elimination of any part from park classification.

THE STATUS OF PUEBLO INDIAN LANDS[1]

WHEREAS, the economic status of the Pueblo Indians in New Mexico is in jeopardy because of various land and irrigation claims of non-Indians; and,

WHEREAS, the United States has justly guaranteed to the Pueblo communities the titles of their lands and the irrigation and other rights pertaining thereto; and,

WHEREAS, every interference with their natural condition will destroy the usefulness of these areas to science and education; and

WHEREAS, the Congress of the United States has recently been considering the passage of laws to quiet land-title disputes between non-Indians and the Pueblos; therefore, be it

RESOLVED, That the American Association for the Advancement of Science, an organization of over 11,000 American scientists and friends of science and education, unequivocally favors the full and complete protection of the Pueblos in all their fundamental land, irrigation and cultural rights, to the end that they may continue to live their own lives in as nearly their own manner as is possible and with as little restriction as is consistent with the rights of their non-Indian neighbors.

SCIENCE AND RELIGION

DR. R. A. MILLIKAN, director of the Norman Bridge Laboratory of the California Institute of Technology, formulated and secured the signatures to the following statement:

A JOINT STATEMENT UPON THE RELATIONS OF SCIENCE AND RELIGION

We, the undersigned, deeply regret that in recent controversies there has been a tendency to present science and religion as irreconcilable and antagonistic domains of thought, for in fact they meet distinct human needs, and in the rounding out of human life they supplement rather than displace or oppose each other.

The purpose of science is to develop, without prejudice or preconception of any kind, a knowledge of the facts, the laws and the processes of nature. The even more important task of religion, on the other hand, is to develop the consciences, the ideals and the aspirations of mankind. Each of these two activities represents a deep and vital function of the soul of man, and both are necessary for the life, the progress and the happiness of the human race.

It is a sublime conception of God which is furnished by science, and one wholly consonant with the highest ideals of religion, when it represents Him as revealing Himself through countless ages in the development of the earth as an abode for man and in the age-long inbreathing of life into its constituent matter, culminating in man with his spiritual nature and all his God-like powers.

RELIGIOUS LEADERS

Bishop William Lawrence, episcopalian, Boston, Massachusetts.

Bishop William Thomas Manning, episcopalian, Bishop's House, Cathedral Heights, New York City.

Dr. Henry Van Dyke, presbyterian, preacher and poet, Princeton, New Jersey.

Dr. James I. Vance, presbyterian, First Presbyterian Church, Nashville, Tennessee.

President Clarence A. Barbour, baptist, Rochester Theological Seminary, Rochester, New York.

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[1] Resolution adopted in principle by the council of the American Association for the Advancement of Science at the fourth Boston meeting, adopted in this form by the executive committee of the council of the association at its regular spring meeting held in Washington, April 22, 1923, and issued from the Washington office of the association, April 25, 1923.

President Ernest D. Burton, baptist theologian, president of University of Chicago.

President Henry Churchill King, congregationalist, Oberlin Theological Seminary, Oberlin, Ohio.

Dr. Robert E. Brown, congregationalist, First Congregational Church, Waterbury, Connecticut.

Bishop Francis John McConnell, methodist, Pittsburgh, Pa.

Dr. Peter Ainslie, disciple, Christian Temple, Baltimore, Maryland.

SCIENTISTS

Charles D. Walcott, retiring president of the National Academy of Sciences, president of the American Association for the Advancement of Science and head of the Smithsonian Institution of Washington.

Henry Fairfield Osborn, president of the American Museum of Natural History.

Edwin Grant Conklin, head of the department of zoology, Princeton University.

James Rowland Angell, president of Yale University.

John Merle Coulter, head of the department of botany, University of Chicago.

Michael I. Pupin, head of the department of electromechanics, Columbia University.

William James Mayo, Mayo Foundation for Medical Education and Research, Rochester, Minnesota.

George David Birkhoff, head of the department of mathematics, Harvard University.

Arthur A. Noyes, director of the Gates Chemical Laboratory, California Institute of Technology.

William Wallace Campbell, director of Lick Observatory and president-elect of the University of California.

John J. Carty, vice-president in charge of research, American Telephone and Telegraph Company.

Robert A. Millikan, director of Norman Bridge Laboratory of Physics.

William Henry Welch, director of the School of Hygiene and Public Health, The Johns Hopkins University.

John C. Merriam, president of the Carnegie Institution of Washington.

Gano Dunn, chairman of the National Research Council, Washington, D. C.

MEN OF AFFAIRS

Herbert Hoover, Secretary of Commerce.

James John Davis, Secretary of Labor.

David F. Houston, ex-Secretary of the Treasury.

Frank O. Lowden, Governor of Illinois.

John Sharp Williams, ex-United States Senator, Mississippi.

Rear Admiral William S. Sims, commander United States Naval Forces in European waters during the World War.

Harry Bates Thayer, president, American Telephone and Telegraph Company.

Julius Kruttschnitt, chairman of the executive committee, Southern Pacific Railway.

Frank Vanderlip, ex-president of the National City Bank of New York.

Henry S. Pritchett, president of the Carnegie Corporation of New York.

THE LIFE AND SERVICES OF PROFESSOR JOHN TROWBRIDGE

THE following minute on the life and services of Professor Trowbridge was placed upon the records of the Faculty of Arts and Sciences at the meeting of April 10, 1923:

John Trowbridge was born in Boston on August 5, 1843, the son of John Howe Trowbridge and Adeline Trowbridge. At the age of eighteen, after attending the Boston Latin School, he entered the Lawrence Scientific School by special arrangement, without any previous scientific training whatsoever. In spite of this disadvantage and the further handicap of a serious financial burden, he graduated with the degree of S.B., *summa cum laude,* in 1865. This brilliant success at Harvard doubtless decided the choice of his profession. Decision must have been difficult, since his interest at that time lay fully as much in the direction of art and literature (which remained delightful avocations) as in the direction of science.

From 1866 to 1869 he was a tutor in physics in Harvard College, and during the following year served as assistant professor of physics in the Massachusetts Institute of Technology. He returned in 1870 to Harvard, where he remained, at first (for ten years) as assistant professor, and afterwards as full professor, until the date of his resignation in 1910—a continuous service of forty years. He received the degree of S.D. in 1873, in 1888 was appointed Rumford professor, and on his resignation became Rumford professor *emeritus.* He was a member of the National Academy of Sciences and the American Philosophical Society, and a Fellow of the American Academy of Arts and Sciences, serving as president of the latter body for seven years. He served also as a member of the International Committee on Electrical Units.

On the twentieth of June, 1877, he married Mrs. Gray (the widow of Thomas W. Gray), of Boston, whose young daughter (now Mrs. Edmund M. Parker) helped her to brighten his life. Mrs.

Trowbridge died in 1907 and his own death occurred in his eightieth year, on the eighteenth of February, 1923.

The earlier part of the long period during which Professor Trowbridge was a member of the teaching staff of Harvard College was characterized by the development of laboratory methods in teaching, and by the recognition of research as one of the fundamental activities of the department of physics. Keenly alive to the lack of adequate facilities for the advancement of his chosen field along these lines at Harvard, Trowbridge projected a great physical laboratory and found the means to construct it. When the laboratory was begun, models for such a building were altogether lacking in this country. Nevertheless, so excellent was its design that it still affords adequate facilities for teaching and research; it forms a lasting monument to the genius of the man who planned it.

For thirty years Professor Trowbridge presided as director over the destinies of the Jefferson Laboratory, devoting part of his time to teaching and a larger part to experimental investigation. Problems connected with spectrum analysis and with the conduction of electricity through gases attracted his attention; and his contributions to scientific literature on these subjects were considerable. It was during the progress of these researches that he realized the importance of a constant source of high potential; accordingly he caused the great storage battery to be constructed, which, unique in its time, is still in constant use, and which has proved of the highest value in the study of X-rays.

To the characteristics of foresight and imagination, Trowbridge added the rare gift of stimulating intellectual activity in others. This stimulus was felt by many classes of persons and produced useful results in varied fields. Under his guidance, many men who have won distinction in science took up problems in research for the first time; among them should be mentioned the late Professor B. O. Peirce and the late Professor W. C. Sabine.

Professor Trowbridge's personality was manifested not only in the intellectual activity which he exhibited, inspired and fostered, but also in unselfish and constant devotion to the needs of his students and colleagues. Both traits of his character contributed toward the sentiment of respect and affection with which his memory will ever be cherished by those who came under his influence.

THEODORE LYMAN
THEODORE W. RICHARDS
GEORGE W. PIERCE
Committee

SCIENTIFIC EVENTS

MEMORIAL TO CHARLES R. VAN HISE

IN memory of the late Dr. Charles R. Van Hise, former president of the University of Wisconsin, a large quartzite rock in Ableman will be dedicated as "The Van Hise Rock" on June 3 with appropriate ceremonies and a tablet marker will be placed upon the rock. The rock is of great interest to geologists and it is considered especially fitting that this rock should be dedicated to President Van Hise, because as a geologist he frequently took his students to the rock and used it in explaining geological theories.

Judge E. Ray Stevens, Madison, president of the State Historical Society, will preside at the dedication. Others who will assist in the ceremonies are Professor C. K. Leith, chairman of the university department of geology; John S. Donald, head of the Friends of Our Native Landscape; W. O. Hotchkiss, state geologist; Joseph Schafer, superintendent of the Wisconsin Historical Society; and Dean Harry L. Russell, of the College of Agriculture.

Part of the inscription on the tablet marker is as follows:

> This rock is pictured in geology text-books as a type illustrating important principles of structural geology and has been a point of special interest to many investigators in geology visiting this region. President Charles R. Van Hise, of the University of Wisconsin, was one of the first and foremost of these.

PROTECTION FOR THE RESULTS OF SCIENTIFIC RESEARCH[1]

FRENCH law protects effectively the rights of authors of literary works, musical composers, painters and sculptors, but this is not true of scientists and inventors. The act of 1844, to be sure, provides for the granting of patents on inventions, but in reality only inventions strictly industrial in their nature come within the scope of this law. No pharmaceutic products or remedies of any kind may be patented. This state of affairs has recently given rise to sharp criticism. It has been emphasized that it is unjust that biologic discoveries and inventions which are of the greatest practical value in agriculture, in veterinary science and in human medicine, and which occupy to-day such an important place in pure and applied science, should be deliberately excluded from the benefits of the law respecting letters patent and should become public property from the date of their origin. The question was made the subject of a long discussion at a meeting of the Confederation of Intellectual Workers and the draft of a law providing for the protection of the rights of scientists has been prepared by a commission. According to this draft, the text of which has been submitted to the chamber of deputies and the League of Nations, the authors of scientific discoveries and inventions shall enjoy, for the duration of their life, the exclusive right of deriving a profit from their invention or discovery. Entitled to protection under this proposed law are: discoveries (that is, demonstrations of the existence of previously unknown principles, bodies, agents or properties of living beings or matter), inventions (that is, creations of the mind consisting of methods, apparatus, products, compositions of products as yet unknown) and, in a general way, all new applications of discoveries and inventions. To establish his right, the author of the discovery or invention must prove that his discovery or invention has been given sufficiently wide publicity. Publication in certain accepted periodicals will be regarded as sufficient publicity. Reproduction for commercial purposes of the name of the author of the published text or of the scientific communication and the bibliographic reference is prohibited, unless the written consent of the author is secured. The authors of inventions and discoveries may not oppose the industrial or commercial exploitation of new applications of their discoveries or inventions, but they will retain an author's rights in any exploitation in which applications of their initial inventions and discoveries have been made. The authors of discoveries or inventions in the domain of therapeutics will participate in the benefits of this law, it being understood that they can not exploit of themselves their discoveries and inventions unless they hold the diploma of a pharmacist.

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[1] *The Journal of the American Medical Association.*

THE TREND OF FORESTRY IN IDAHO

AT an open meeting of the Idaho Chapter of Sigma Xi, recently held at the University of Idaho, Moscow, "The trend of forestry in Idaho" was presented by Dean F. G. Miller, Professor C. Edward Behre and Dr. Henry Schmitz of the forest faculty. Dean Miller discussed the economic phases of the forestry situation particularly in north Idaho, where is found the largest body of white pine extant. He pointed out that about 48 per cent. of the timber in this part of the state was owned privately while the government held forty per cent. and the state about twelve per cent. He further showed that the greater bulk of the privately owned timber would in all probability be exhausted in the next twenty-five to thirty years. Since the government and the state can not supply on a sustained yield basis more than a fraction of the present annual cut, a serious slump in the lumber industry is inevitable.

Professor C. Edward Behre presented a series of lantern slides showing conditions in the Western White Pine and Western Yellow Pine stands of Idaho during and after logging operations, illustrating how these forests could be kept continuously productive if cut under national forest regulations and protected from the ravages of fire. The slides presented demonstrated the futility of the broadcast burning of logging slash as a permanent protective measure in the white pine forests and showed the tremendous waste in destruction of advance young growth which broadcast burning caused in both the white and yellow pine types. The need for research in forestry was emphasized by pointing out the various problems arising in providing for future forest growth.

Dr. Henry Schmitz spoke on the "Trend of research in forest products." The point was emphasized that the United States is annually consuming over four times as much timber as is produced by the forest areas and that this state of affairs can not go on indefinitely. The problem can partly be solved by increasing the yield of the various products made from wood. The place of research in this connection was discussed at some length particularly as applying to wood preservation, wood distillation, the manufacture of paper pulp and kiln drying.

SYMPOSIUM ON COLLOID CHEMISTRY AT THE UNIVERSITY OF WISCONSIN

THE University of Wisconsin announces a public symposium on Colloid Chemistry, to be held at Madison from June 12 to 15, 1923, inclusive. All interested are cordially invited to attend and to participate in the discussions.

Room reservations will be made for those guests who send notification of their expectation to attend. Such reservation is desirable as the hotel facilities in the city are somewhat limited. Such notification should be sent at once to Professor J. H. Mathews, Department of Chemistry, University of Wisconsin.

Attention is called to the fact that Professor Svedberg will give a series of about twenty-four lectures on colloid chemistry during the summer session of the university (June 25 to August 4). The program of the lectures is as follows:

The colloidal state in metals and alloys: J. ALEXANDER.

Precipitation of sols by alcohol: W. D. BANCROFT.

Membrane potentials and their relation to anomalous osmose: F. E. BARTELL.

Conditions affecting the hydrolysis of collagen to gelatin: R. H. BOGUE.

Thermochemistry of sulfur sols: F. L. BROWNE.

General considerations of the forces determining the limiting size of the colloidal particle in any given solution: E. F. BURTON.

On the theory of the lyophilic colloids: MARTIN FISCHER.

The application of colloid chemistry to agricultural problems: R. A. GORTNER.

Gel formation: H. N. HOLMES.

On the precipitation of colloidal metals by means of metals in the solid state: L. KAHLENBERG.

The colloid chemical problems in the manufacture of enzymic and animal glandular products: D. KLEIN.

The thermochemistry of protein behavior: J. H. MATHEWS AND B. W. ROWLAND.

Dispersity of silver halides in relation to their photographic behavior: S. E. SHEPPARD.

Colloidal properties of rubber and compound ingredients: E. B. SPEAR.

Demonstrations of colloid chemistry technique: THE. SVEDBERG.

The problems of adsorption from the standpoint of catalysis: H. S. TAYLOR.

The formation of inorganic jellies: H. B. WEISER.

The swelling of protein jellies: JOHN A. WILSON.

Surface films as plastic solids: ROBERT E. WILSON.

MEDICAL FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

THESE fellowships are supported by joint contributions of The Rockefeller Foundation and the General Education Board and are administered by a special medical fellowship board of the National Research Council.

The fellowships are open to citizens of both sexes of the United States and Canada who possess an M. D. or a Ph. D. degree, or the equivalent of one of these degrees. They are intended for recent graduates and not for those already professionally established.

The basic stipends awarded are $1,800 for unmarried and $2,300 for married fellows per annum. These stipends may be increased when there are other dependents or for other cogent reasons. Awards are made for one year, but fellowships may be renewed. Fellows are chosen at semi-annual meetings of the medical fellowship board in April and September and applications to receive consideration at these meetings must be filed on or before March 1 and August 1, respectively. Appointments may date from any period subsequent to the board meetings.

The fellowships are designed to recruit men and women as medical teachers and investigators. Fellows may choose any branch of medicine or public health for their ultimate career, but at present those candidates (otherwise suitable) will be favored who plan to specialize in one of the preclinical sciences or to approach clinical medicine through temporary identification with one of the sciences.

The fellowships are not granted to any institution or university, but the choice of place to work, either in this country or abroad, is left to the fellow, subject to the approval of the fellowship board. The appointments are for full time and no other remunerative or routine work is permitted.

The particular individual with whom a fellow wishes to work should ordinarily have agreed to accept him prior to the consideration of his application by the board.

Opportunities, but not obligations, for a certain amount of teaching must be available. It is further required that the fellow be charged no fees or tuition by the institution where he chooses to work.

Further particulars concerning these fellowships may be obtained by addressing the Chairman, Board of Medical Fellowships, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

The men's dormitory that is being built by the board of athletic control of Stanford University out of income from the stadium as a gift to the university will be given the name Branner Hall, to commemorate the services to Stanford University and the sympathetic interest in student affairs of the late John Casper Branner, pioneer member of the faculty, first head of the geology department and second president of the university.

At a recent meeting of the board of curators of the University of Missouri, the name of the biology building which houses the departments of zoology and botany was changed to Lefevre Hall in honor of the late Professor George Lefevre's labors for the university, aside from his porated in the board's action: "Professor Lefevre's labors for the university, aside from his connection with this building, merit such a memorial. But there is further justification for thus honoring his memory; the biology building is his creation more than that of any other man. During its construction the architects, the administrative officers of the university and his associates in the department of zoology alike acknowledged a leadership culminating in a laboratory that continually excites admiration for its beauty, its convenience and its effectiveness in meeting the needs of the departments of botany and zoology."

The funeral of the late Arthur Gordon Webster at the chapel of the Massachusetts Crematory Society was attended by Dr. Charles W. Eliot, president emeritus of Harvard University, and nearly a hundred professors from Harvard University, the Institute of Technology and Clark University. The pall bearers were Dr. G. Stanley Hall, president emeritus of Clark University; Dr. Ira N. Hollis, president of Worcester Polytechnic Institute; Dr. William E. Story, former professor of mathematics at Clark and Harry Worcester Smith, all of Worcester; Dr. Michael I. Pupin, of Columbia University; Dr. Philip Kilroy, of Springfield; President S. W. Stratton, of the Massachusetts Institute of Technology, and Professors Edwin H. Hall, Charles R. Lanman and George F. Moore, of Harvard University.

Dr. Frank J. Monaghan has been appointed commissioner of health for New York City, succeeding Dr. Royal S. Copeland, elected to the United States Senate. Dr. Monaghan has been sanitary superintendent of the city for the past five years.

Dr. Oliver Bowles, mineral technologist of the Bureau of Mines, has been designated by the secretary of the interior as superintendent of the new mining experiment station of the bureau to be established at Rutgers College, New Brunswick, New Jersey, which will specialize in problems involved in the production and utilization of the various non-metallic minerals. Dr. Bowles will enter upon his new work on July 1.

Dr. George W. Hoover, for the past nine years chief of the Chicago district of the U. S. Department of Agriculture, has been appointed chemist in charge of the drug control of the United States.

At a banquet of the Chicago Section of the American Chemical Society on May 25, the Willard Gibbs Medal was presented to Professor Julius Stieglitz, of the University of Chicago, in recognition of his research work on molecular rearrangement and his interpretation of univalent nitrogen. The medal was presented by its founder, Mr. W. A. Converse.

In commemoration of his eightieth birthday, a dinner was given on May 3, to Dr. Henry M. Hurd, professor of psychiatry in the Johns Hopkins Medical School.

A banquet was given on May 28 in honor of Professor Filibert Roth, for twenty years a member of the forestry department of the University of Michigan, by the foresters of the state. Among the speakers were Dean F. F. Moon, of the New York State College of Forestry; Professor Ralph S. Hosmer, of Cornell University, and President Marion L. Burton.

A prize medal has been endowed in honor of Professor Hans Horst Meyer, of Vienna. It is to be awarded every five years for distinguished work in the domain of theoretical medicine. It was presented for the first time to Professor Meyer himself on the occasion of his recent sixtieth birthday.

Dr. Henry Kraemer, Mount Clemens, Michigan, has been elected an honorary member of The Pharmaceutical Society of Great Britain.

At the spring meeting of the Association of Virginia Biologists, held at the College of William and Mary on April 27, the Virginia Academy of Science was organized. Dr. I. F. Lewis, of the University of Virginia, was elected president and Dr. E. C. L. Miller, of the Medical College of Virginia, secretary-treasurer. In response to an announcement of the proposed organization sent out before the meeting, more than one hundred and fifty have signified their intention of becoming members of the new academy. The next meeting of the academy will be held at Washington and Lee University, Lexington, Virginia, during the first week in May, 1924.

Harris J. Ryan, professor of electrical engineering at Stanford University, California, was elected president of the American Institute of Electrical Engineers at the annual business meeting on May 18. Vice-presidents elected were: H. E. Bussey, Atlanta; S. E. M. Henderson, Toronto; William F. James, Philadelphia; J. E. Macdonald, Los Angeles; Herbert S. Sands, Denver. The annual report of the board of directors presented at the meeting showed a net increase in the membership during the year of 1,035, the total membership on April 30 being 15,298.

Dr. Payson Clark, of Boston, was elected president of the American Laryngological Association at their forty-fifth convention held at Boston on May 19.

Professor George H. Shepard, member of the American Society of Mining Engineers and professor of industrial engineering and management at Purdue University, has been appointed to succeed Frank B. Gilbreth as chairman of the committee on fatigue elimination of the Society of Industrial Engineers.

Dr. A. E. Jenks, professor of anthropology and director of the Americanization Training Course of the University of Minnesota, has been appointed chairman of the division of anthropology and psychology of the National Research Council for the year 1923-24. Dr. and Mrs. Jenks will move to Washington on September 1. During the summer Professor Jenks will give two courses of lectures in the department of education in the summer session of the University of California (Southern Division) in Los Angeles.

Professor W. A. Noyes, head of the department of chemistry at the University of Illinois, has been granted a year's leave of absence which he is planning to spend in Europe. Professor Noyes is a delegate of the National Research Council to the International Union of Pure and Applied Chemistry, meeting in Cambridge from June 17 to 24, and a delegate of the American Association for the Advancement of Science to the British Association meeting in Liverpool in September. He will also attend a conference of the Faraday Society on the subject of atomic structure which will be held in Cambridge in July.

Members of the Williams Galapagos Expedition, including Dr. William Morton Wheeler, of the Bussey Institution of Harvard University, and Dr. William Beebe, leader of the expedition, arrived in New York on the steam yacht *Nona* last week, after a ten-week cruise among the Galapagos Islands, off the coast of Ecuador.

Dr. A. B. Stout, of the New York Botanical Garden, who has been in residence at Pomona College during the year, has been making a study of the citrus industry and also of the date and avocado culture. Dr. Stout has been asked by the United States Department of Agriculture to return to Southern California next year to continue this special research work under government direction.

Charles W. Gilmore, paleontologist, of the United States National Museum, has left Washington to superintend the unearthing of the fossil remains of a dinosaur discovered near Jensen, Utah.

Dr. W. A. Osborne, professor of physiology at the University of Melbourne, has returned to Melbourne after a study leave of absence in America and Great Britain.

WILFRED G. PARKINSON, of the Carnegie Institution of Washington, sailed on May 3 en route to Huancayo, Peru, to make observations at the observatory of the department of terrestrial magnetism.

PROFESSOR MARCUS E. JONES, of the University of Utah, whose botanical collection has recently been acquired by Pomona College through the generosity of Miss Ellen Scripps, of La Jolla, has arrived in Claremont. He will make this his residence and will cooperate with Dr. Philip A. Munz in the arrangement of the herbarium.

DR. EDGAR F. SMITH will give the commencement address at the University of Kansas. He will also address the Arkansas section of the American Chemical Society on July 12.

ON May 11, Professor F. R. Moulton, of the University of Chicago, was the guest of the mathematics department and the Sigma Xi and the Pi Mu Epsilon honorary fraternities of the Ohio State University. After the dinner, he gave a public address on "Some rambles in space and time."

DR. CARL L. ALSBERG, director of the Food Research Institute, Stanford University, San Francisco, delivered a lecture on "Economic aspects of our food supply" before the School of Hygiene and Public Health of the Johns Hopkins University on April 16.

DR. JAMES E. ACKERT, of the Kansas State Agricultural College, delivered the annual Phi Kappa Phi address at the Oklahoma Agricultural and Mechanical College on May 22. The subject of his address was "The relation of the hookworm to medical and agricultural education."

PROFESSOR CHARLES T. KNIPP, of the department of physics of the University of Illinois, addressed on May 18 the annual meeting of the Indiana Physics Teachers' Club, held under the auspices of Rose Polytechnic Institute and the Indiana State Normal School, on "The historical development of the three electrode vacuum tube."

A SPECIAL meeting of the Linnean Society of London was held on May 10, when Professor Paul Kammerer, of Vienna, lectured on his experiments concerning "The inheritance of acquired characters."

THE Croonian lectures before the Royal College of Physicians of London will be given by Professor J. B. Leathes, F.R.S., on the subject of the part played by fats in vital phenomena. There will be four lectures, which will begin on June 7.

DR. HANS GOLDSCHMIDT, German chemist and inventor of the thermit process of welding iron and steel, died in Baden-Baden, Germany, on May 20.

THE trustees of the National Geographic Society have authorized a tablet at Camp Clay, Cape Sabine, in the Arctic, in memory of the eighteen men of the Greely expedition who died there in 1884. Major General A. W. Greely, retired, dean of living Arctic explorers and leader of the party, now lives in Washington. The tablet is one of a series the Geographic Society will place as memorials to Americans who have made history in Polar explorations. Memorials to Rear Admiral Peary, discoverer of the North Pole, and to Rear Admiral Charles Wilkes, discoverer of the Antarctic continent, have already been erected in Arlington National Cemetery, Washington. The tablet to the Greely party will be carried by Donald B. MacMillan when he starts north in June for further explorations of the Arctic and it will be placed in position by him on the rock cliff facing the camp.

DURING the exposition to illustrate the advances in science due to Pasteur's discoveries, which will follow the unveiling of the Pasteur monument at Strasbourg on June 1, medical and scientific congresses will be held as follows: June 1, Hygiene and bacteriology; June 2, Tuberculosis; June 11, Ophthalmology; July 23, Cancer; July 24, Dermatology and syphilology, and July 26, Leprosy.

THE Congress of Intellectual Workers, which was to have taken place at Berne on July 6 and 7, has been postponed.

THE sixth congress of the International Surgical Association will be held in London from July 17 to 20, under the chairmanship of Sir William Macewen.

THE Clinical Surgical Society of America will hold its thirty-sixth annual meeting at Washington University School of Medicine on

May 28 and at the clinic of Dr. Willard Bartlett at the Missouri Baptist Sanitarium May 29. Papers by local surgeons will be delivered on recent advances on thoracic and cardiac surgery, X-ray therapy and kindred subjects.

UNIVERSITY AND EDUCATIONAL NOTES

HALF a million dollars has been appropriated by the New York State legislature to start work on a new plant industries building for the College of Agriculture at Ithaca. A few years ago the state adopted a program that called for the expenditure of $3,000,000 and the college has been empowered to proceed in a building plan in accordance with this appropriation, though it may not expend more than the amount made available in any one year.

THE residue of the estate of the late George E. Hoadley, of Trinity College, is to be divided equally between Trinity College and the Connecticut Historical Society. Each institution will receive about $200,000.

PROFESSOR W. A. HAMILTON has been appointed chairman of the administrative interim committee of Beloit College, until a president of the college is appointed to succeed President M. A. Brannon, who was recently made chancellor of the University of Montana. Professor H. H. Conwell has been appointed acting head of the department of mathematics.

DR. DAVID FRIDAY, president of the Michigan Agricultural College, has presented his resignation to become effective on June 1. The State Board of Agriculture accepted the resignation over the protest of Governor Groesbeck. Dr. Friday has accepted a professorship of economics at the new school for Social Research in New York City.

DR. BRADLEY STOUGHTON, formerly of Columbia University and later secretary of the American Institute of Mining and Metallurgical Engineers, a New York consulting engineer, has been appointed professor of metallurgy at Lehigh University.

DR. HARRY A. CURTIS, government nitrate expert, has accepted an appointment as professor of chemical engineering at Yale University.

AT the University of Chicago, Dr. Andrew C. Ivy, of Loyola University, has been appointed associate professor of physiology and Ernest P. Lane, of the University of Wisconsin, assistant professor of mathematics.

DISCUSSION AND CORRESPONDENCE

DYE SOLUBILITY IN RELATION TO STAINING SOLUTIONS

IN a recent note appearing in these pages[1] attention was called to the fact that different batches of stain may contain very different amounts of actual dye; hence, staining solutions made up according to formulae calling for so many grams of dry stain may vary considerably in their actual strength. For this reason it was recommended in the note above mentioned that solutions of stain be made up by using definite quantities of saturated solution of the stain. In this way it was believed that the resulting solutions would be much more nearly the same strength than when prepared on the basis of weight of the dry stain.

There seems to be no question but that this statement is correct as far as it goes; but since the publication of the above mentioned article a certain serious criticism of the procedure recommended has been brought to our attention. It seems that the solubility of a dye varies considerably according to the amount and kind of mineral matter present in solution. It is well known in the dye industry that many of the dyes may be "salted out" of solution, that is precipitated by the addition of some mineral salt. Now the inert material present in many samples of stain is of a mineral nature and may act in the same way. There is never enough present to prevent the dye itself from going into solution, but there is often enough to lessen its solubility. For this reason two staining solutions made up from a pure and an impure dye, respectively, each containing ten per cent. of a saturated alcoholic solution may vary considerably in their actual dye content. This is not only theoretically true, but practical experience in the handling of stains has shown that it may actually be the case.

On account of this fact it is very plain that preparing a stain on the basis of saturated alcoholic solution is not an ideal procedure. At the present time it is perhaps the best method possible, since many different brands of stain are available which vary greatly in their total dye strength without any indication to the purchaser as to what their actual dye content may be. Solutions made up as recommended in the previous article will certainly be more nearly constant than those prepared on the basis of dry weight under such circumstances as these; but the procedure is far from satisfactory.

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[1] The preparation of staining solutions, SCIENCE, 67, January 5, 1923, p. 24.

The ideal to be hoped for is this: That every manufacturer of stains print on his label the actual dye content and the moisture content of the particular batch of stain on which the label is placed; and that every one publishing stain formulae prepare them on the basis of weight of *pure dye*. Such staining formulae will be very different from the ones found in the literature at present, because most of the latter were prepared on the basis of stains that were seldom more than fifty per cent. actual dye strength. Of course, it is too much to expect such a revolution in the preparation of staining formulae immediately; but the first step has already been taken in that one of the stain companies has promised to place on every label the information concerning dye strength and moisture content which is necessary. Any one writing a text book or article in which stain formulae will be given is urged to pay attention to this fact and so far as possible to cooperate with the commission in publishing stain formulae in standardized form. The commission will be very glad to cooperate with any one who wishes to adopt this new form of stain formulae and will furnish any necessary information which is available.

Commission on the Standardization of Biological Stains.

H. J. Conn
Chairman

"THE NEW AIR WORLD"

In Science of March 30, Dr. William J. Humphreys, under the caption "Three of a Kind," criticizes my recent book, "The New Air World." His criticisms are so lacking in accuracy that I assume you will allow me space in which to answer some of them. It is a fact that I shall be glad to verify with documentary evidence for your inspeciton that this book has been highly commended by many scientists of high standing and that to my knowledge there is not an unfavorable criticism of it except by Humphreys and Alexander McAdie.

In 1910, through the Appleton Press, I published a college text-book called "Descriptive Meteorology." In the preface of this book it is clearly stated that I "consulted with and received valuable aid from Professor W. J. Humphreys on many technical points in the physics of the book," and it is a fact familiar to many officials of the Weather Bureau that Humphreys read every galley proof and every page proof of that book and that I made changes in my original copy as the result of his suggestions and that this book had his approval, as it was intended for the teaching of the observers and others of the bureau with whom he was expected to be in close association in the future. Now any one in comparing this book with the one that Professor Humphreys now so severely criticizes and which he says "contains scores of errors and numerous loose and inaccurate statements" will see that the second book is simply the first book stated in popular language for the lay reader and for pupils of the grammar schools, with the addition of a few entirely new chapters, and these new chapters he has not specifically attacked. Much of what he approved then he disputes now.

First, he objects to the book because it contains material "merely of the grammar-school grade," when in point of fact the author did not intend it for anything more, saying in his introduction: "an effort (is) made to tell a simple story that will awaken curiosity and lead the reader to wish to know more and more of the mysteries of the atmosphere."

Second: he quotes from page 8 of my book the statement that "The atmosphere is thus by the absorption of radiation warmed largely from the bottom upwards, which accounts for the perpetual freezing temperatures of high mountain peaks, although they are nearer the sun than are the bases from which they rise."

Then he says: "This, as any physicist knows, is a wholly inadequate explanation of the phenomenon in question." But he withholds from the reader the fact that page 8, from which he extracted only five lines, contains what I believe a competent person would regard as a "wholly adequate explanation." It is as follows:

> Oxygen and nitrogen, which form the greater part of the atmospheric gases, absorb comparatively little of the solar rays, while water-vapor, which constitutes a little more than one per cent. of the atmosphere and which remains close to the earth, absorbs large quantities. From the fact that one half of the atmosphere, including nearly all of its water-vapor, lies below an elevation of three and one half miles, it becomes evident that the greater part of the absorption of the sun's rays must take place in the lower strata. On clear days the atmosphere absorbs nearly one half of the sun's rays; the remainder reaches the surface of the earth, warms it and in turn is radiated back into the air—with this difference: that as earth radiation the wave motion of the rays is longer and slower than it was when the rays entered our atmosphere as solar radiation. In this slower form the rays are more readily absorbed. The atmosphere is thus warmed largely from the bottom upwards, which accounts for the perpetual freezing temperatures of high mountain peaks, although they are nearer the sun than are the bases from which they rise.

Now read the explanation that Humphreys gives of this phenomenon in his criticisms published in SCIENCE on March 30 last, and judge as to which is the more lucid and "adequate":

> Absorption at the surface in excess, on the average, of radiation; and radiation of each portion of the upper air, up to eleven kilometers, roughly, above sea level, in excess, on the average, of absorption, are the necessary and sufficient causes, through the convection thus maintained, of the practically continuous state of decrease of temperature, in this lower portion of the atmosphere, with increase of height.

Talk about "loose and inaccurate" statements! I submit this as a sample of incoherency well knitted together; and it is about as "inaccurate" as anything well could be, for no one ever before heard of "convection" being "thus maintained." I must further embarrass Professor Humphreys by stating that the explanation given by me in "The New Air World" and which he criticizes may be found substantially in substance on page 82 of "Descriptive Meteorology" hereinbefore mentioned, which he carefully read and approved before it was published and he never has repudiated the credit given him in the preface of that work.

Third: he disputes my statement about the hour of maximum temperature reversing from day to night at the altitude of about one and one half miles and says that if I "had first studied the records" I would have found that "the lowest temperature at level *is* at night, or more exactly at 5 to 6 A. M., substantially as at the surface."

Here again the cold records will embarrass Professor Humphreys, but I will have to leave him to contend with Dr. William R. Blair and Professor Charles F. Marvin, chief of the Weather Bureau, with whom he comes squarely into conflict. As chairman of the sub-committee on the relations of the atmosphere to aeronautics, submitted to the National Advisory Committee during the World War, Professor Marvin approved report No. 13, written by Dr. Blair. On page 46 of this report it is stated: "The afternoon maximum temperature disappears between the 1.5 and 2 kilometers levels in the summer months and between 1 and 1.5 kilometers levels in the winter months," and pages 47 and 48 diagrammatically present the information and show Humphreys in error.

I have answered specifically but three of Professor Humphreys' criticisms, but I think these answers are sufficiently "adequate" to show the nature of all of them.

WILLIS L. MOORE

With your kind permission I shall reply briefly to the above rejoinder.

So far as I know (and I have inquired at the library of the Weather Bureau) none of the eminent scientists who "highly commend" "The New Air World" has published his commendation in a reputable scientific journal.

If any one is sufficiently interested and knows meteorology I can show him more than one hundred errors and loose statements in this book.

As to my responsibility for the statements that appear in "Descriptive Meteorology," allow me to say that Professor Moore is entirely too lenient. I read not only the proof of this book but also the original manuscript in its different stages and removed an amazing number of errors. I also wrote chapter VIII and portions of some others; nor was I alone in making such requested contributions. Finally, the late Cleveland Abbe put much labor on the proof. In short, everything practicable was done, with the material in hand, to save the bureau's face. Nevertheless, a number of errors still remain in this book, including the insufficient explanation of the cold of mountain peaks.

The longer quotation from "The New Air World" does not help matters and would not even if so rewritten as to be precise. From the fact that the lower atmosphere is a better absorber, in general, of solar and terrestrial radiations than is the upper, one might *jump* to the conclusion that therefore the temperature of the air must rapidly decrease with increase of elevation. But, then, the lower atmosphere is, in general, a much better radiator than is the upper air, and so one might with equal reason *suppose* that the temperature of the air must rapidly increase with increase of elevation. If confronted with the fact that the lower atmosphere is both a better absorber and a better radiator than is the upper he might *guess* that there would be but little change of temperature with change of elevation. In each of these cases the argument is inconclusive. The complete explanation, though it could be elaborated into a chapter, is outlined in the sentence which Professor Moore says he is unable to follow—a summation appropriate to a scientific journal and entirely clear, as I know from actual tests, to those who understand the phenomenon under discussion.

As to the time of day at which the minimum temperature occurs, on the average, at an altitude (author does not state whether above surface or sea-level) of one and a half miles, let me say that Dines, in his paper "The characteristics of the free atmosphere," Meteorological Office, London, 1919, reviews all the contributions, about half a dozen, that up to that time had been published on the daily temperature range in the free air and concludes that this range decreases rapidly with height and that above two kilometers the range is so small that it is uncertain when either the maximum or minimum occurs. Beginning with 1916, however, the Weather Bureau has collected a large amount of information on this subject which shows that at a mile and a half above the surface at the station (Drexel) where this information was obtained the diurnal temperature range is small and that the minimum and maximum temperatures, respectively, occur, on the average (seasonal and annual), at about the same times at this level as at the surface, as perhaps one would expect to be the case, except at the times and places of strong vertical convection.

Professor Moore's excuses for the above two errors do not, as he implies, prove that he was right in saying that at the altitude of 100 miles the temperature is absolute zero; that there could be no atmosphere if the temperature were below —346° F.; that without dust there could be no light; that ozone is highly electrified oxygen, etc., etc.

Finally, let me say that an accurate elementary book merits the highest praise, for it does great good; while a grossly inaccurate one deserves severe condemnation, because of the harm it works through misinformation to children and other unsuspecting victims.

W. J. HUMPHREYS

QUOTATIONS

MR. BRYAN, THE CHURCH AND EVOLUTION

THOUGH Mr. William J. Bryan regards the defeat of his resolution against Darwinism in the Presbyterian General Assembly as a personal humiliation and is said in the press reports to have "sunk into his seat so pale as to appear almost ill" yesterday when the vote against the resolution was declared, it is hard to see how even a conservative believer can be displeased by the resolution on the subject which was adopted by the Assembly. This resolution declares

> that Synods and Presbyteries within whose bounds Presbyterian supported academies, colleges and training schools are located are hereby instructed to exercise careful oversight over the instruction given in such institutions, and that Synods and Presbyteries withhold their official approval from such academies, colleges and training schools where any teaching or instruction is given which seeks to establish a materialistic evolutionary philosophy of life which disregards or attempts to discredit the Christian faith.

The bases of belief would appear to be entirely safe, in Presbyterian or other schools, under such an instruction as that. But Mr. Bryan wished to go further. He proposed to consign a man named Darwin, who never had anything to do with the doctrine or practice of the church, who was a man of science and who merely went through life trying to find out what was true, to ignominy. The resolution which he offered and eloquently advocated declared

> that no part of the Educational Fund of the Presbyterian Church of the United States of America shall be paid to any school, college, university or theological seminary that teaches, or permits to be taught as a proven fact, either Darwinism or any other evolutionary hypothesis that links men in blood relationship with any other form of life.

The difference between the two resolutions is significant and fundamental and the decision of the Presbyterian General Assembly is highly important, because by implication it recognizes the fact that perhaps teachers who are as much devoted to the Christian faith as any other may not exclude consideration of the evolutionary philosophy from their teaching; in other words, that an evolutionary philosophy need not by them be regarded as altogether materialistic in its bearings. The Bryan resolution approaches, with a bludgeon merely, a subject which may well engage the attention and summon up the wisdom of the most devout. Manifestly the Presbyterian Church is not prepared to take that attitude.

The Presbyterian Church, in short, avoids the imputation of assuming infallibility. It rests upon the Christian doctrine and proposes to continue to rest upon it, but does not bind the conscience of believers with bands of theological steel. But this is precisely what it would have done if it had adopted the remarkable resolution offered by the Rev. Edward H. Pence of Portland, Oregon, which made this declaration:

> That man was evolved with all his mental, moral, spiritual content to his consciousness of self and God by the operation of laws inherently within a form from which he came, and the acknowledgment of possibilities, or even probabilities, that a physical organism may have been evolved by forces and processes implanted by God, sacred, because so chosen and used by Him, and that his organism did not and could not have become human until, by creative fiat of God, he breathed into it the inherent parts which constituted man as the potential son of God.

The defeat of this resolution and Mr. Bryan's, taken together with the temperate declaration which was actually adopted, indicates that the day is past when the right of ecumenical conclusiveness is likely to be assumed by American Protestant bodies.—*The Boston Evening Transcript.*

SCIENTIFIC BOOKS

The Meaning of Relativity. By ALBERT EINSTEIN. (Princeton lectures translated into English by E. P. Adams.) Princeton University Press. 1922.

The present state of the remarkable theory of relativity of Albert Einstein, the degree of maturity which the investigation has reached, the extensive and varied development of the subject which has been set forth in so large a literature, the doubts and difficulties which the theory has encountered, the enthusiasms which it has engendered, the antagonisms which it has aroused, the difficult form which much of the exposition of it has taken, its intimate relations with the deepest realities accessible to investigation—all these render imperative such an exposition of the subject as will make it accessible to a large body of persons interested in the more profound consequences of physical theory. The preliminary announcement of the publication of "The meaning of relativity" by Albert Einstein raised the hope that this book would serve just that purpose.

In a small volume of 123 pages we have here four lectures by Einstein: the first is on "Space and time in pre-relativity physics"; the second is on "the theory of special relativity"; both the third and the fourth bear the title "The general theory of relativity." The lectures open with a brief investigation of the origin of our ideas of space and time and a discussion of the object of science as a means of coordinating our experiences and of bringing them into a logical system. Subjective time is not measurable; we can assign numerical measures to time only by means of some objective phenomena which are recurrent. Simultaneity at different places is a notion of which we do not have immediate awareness. We require some convention or agreement before we can say whether distantly separated events are simultaneous or not. In following up this idea one cannot avoid an intimate association of space and time. A realization of this brings him towards one of the fundamental notions of the theory of relativity, namely, that measured space and time are so intimately connected and entangled that we can not deal with either apart from the other. We are forced to think of space and time as indissolubly conjoined into a four-dimensional continuum of space-and-time. This intimate junction of two things previously separated, a junction necessary at least in the measurements of physics, is one of the basic conceptions on which the whole theory of relativity rests. In his first lecture Einstein shows how this comes about and gives something of the mathematical means by which this conjoined space-and-time is to be investigated.

The second lecture is devoted to the milder form of the theory of relativity as Einstein presented it in 1905. This special relativity can be treated without any very complicated mathematical machinery, though even here a full understanding of its detailed development is impossible without considerable mathematics. Einstein here develops the main part of this theory in intimate connection with the various general ideas to which it is related. The exposition is suited to the needs of a serious student of the subject who has already acquired some of the simpler ideas.

Now this special relativity is not comprehensive enough to embrace the phenomena of nature beyond a certain rather narrow range. A more general theory is necessary to bring about agreement with cosmic phenomena. Einstein's construction of this more general theory was set forth in a memoir of 1915. The third and fourth lectures of the present volume are devoted to an exposition of that more general theory. An attempt is made to show the nature of its details and to explain its connections with the famous phenomena of astronomy which have afforded so remarkable a verification of the theory. Full details can not be given in so short an exposition. But the author can and does succeed in making clear the general ideas and in setting before the reader the spirit and trend of the argument and in leading him to see much of the detail of the whole theory. The exposition is thus a very useful one.

A review of such a brief book on relativity should not be ended without indicating the place which it should have with a learner who is working himself into a knowledge of the theory. It is obvious that the book must be authoritative. But it cannot serve as a single volume to lead the reader into a fair introductory knowledge of the whole theory; indeed this was not the purpose of the book. (The reader who desires a single short volume suited to lead him to a fair preliminary conception of the whole subject will find such a book in the second edition of my "Theory of relativity" published by Wiley & Sons, New York.) But the book can be made to serve an important purpose for the learner who wants a fairly rapid and yet comprehensive introduction to the whole theory. He might well begin with Einstein's more elementary book (translated by Lawson, published by Holt & Co. in 1921) entitled "Relativity—the special and general theory." This will lead him readily into the simpler aspects of the theory. This might be followed with the book named at the head of this article. He could then proceed to Weyl's comprehensive "Space—time—matter" (translation by Brose published by Dutton in 1922). Or, he might precede Weyl's book by Eddington's "Space, time and gravitation." By means of these four or five books, all of them available in English, it is possible for one to get a rapid and comprehensive introduction to the whole theory of relativity. They are recommended only to the serious student of the subject. None of the volumes constitutes "light reading."

R. D. CARMICHAEL

TUBEUF'S MONOGRAPH OF THE MISTLETOE

ONE of the most encouraging signs of surviving intellectual life in Mid-Europe is the occasional appearance of masterly publications like the MONOGRAPHIE DER MISTEL (The Oldenbourg Verlag, Munich) by Professor Tubeuf of the University of Munich. For many years

Tubeuf has stood well to the forefront among plant pathologists in the world and his publications on the mistletoe are classic.

The present quarto volume (xii+ 832 pages, 181 text-figures, 35 plates and five distribution maps) will form the starting point for all future studies of this interesting autotrophic plant which nevertheless is parasitic and even divisible into biologic strains in its host selection.

From the day of Theophrastus, the Greek founder of botanical science, the rôle of the mistletoe in saga, folklore and practical horticulture is sketched, and its present-day significance is shown. Special chapters deal with geographic distribution, morphology in its various branches, ecologic relations with other plants and animals, and its many-sided significance as a harmful parasite or an attractive adjunct to a landscape.

Every American University library should possess the book, and no surer indication can be given of America's wish to help the countries of Europe in the heroic struggle of their scholars to hold fast to what they have of culture, than by the prompt purchase of such sterling works as Tubeuf's monograph now that the Mid-European scholar is so hard pressed to keep body and mind and soul together.

William Trelease.

University of Illinois,
Urbana, Illinois

SPECIAL ARTICLES

FURTHER NOTES ON THE "WINTER CYCLE" IN THE DOMESTIC FOWL

In an earlier note[1] we pointed out that the maximum value of the inter-annual correlation between the egg production of the various "cycles" of laying activity in the first and second year in the White Leghorn fowl does not fall on the winter "cycle" as might be expected from current genetic theory, as developed for the Barred Rock breed, but on the autumn "cycle."

We have since shown[2] that the relationship between the first year production of the mother and the first year production of the daughter is $r = 0.128 \pm .033$ while that between the

TABLE 1. DAUGHTER'S FIRST YEAR.

		Winter	Spring	Summer	Autumn	Annual
Mother's First Year	Winter	+.1387 ± .0330 4.20	+.0593 ± .0335 1.77	—.0011 ± .0336 0.03	+.0596 ± .0335 1.77	+.0976 ± .0333 2.93
	Spring	—.0064 ± .0336 0.19	+.0246 ± .0336 0.73	+.0174 ± .0336 0.51	+.0876 ± .0334 2.62	+.0365 ± .0336 1.08
	Summer	—.0084 ± .0336 0.25	+.0074 ± .0336 0.22	+.1173 ± .0332 3.53	+.0429 ± .0336 1.27	+.0564 ± .0335 1.68
	Autumn	+.0727 ± .0335 2.17	+.0377 ± .0336 1.12	+.0750 ± .0335 2.23	+.1991 ± .0323 6.16	+.1320 ± .0331 3.98
	Annual	+.0959 ± .0333 2.87	+.0536 ± .0336 1.59	+.0721 ± .0335 2.15	+.1380 ± .0330 4.18	+.1279 ± .0331 3.86

TABLE 2. DAUGHTER'S FIRST YEAR.

		Winter	Spring	Summer	Autumn	Annual
Mother's Second Year	Winter	+.0578 ± .0335 1.72	+.1057 ± .0333 3.17	+.1025 ± .0333 3.07	+.1630 ± .0327 4.98	+.1440 ± .0329 4.37
	Spring	+.0743 ± .0335 2.21	+.1496 ± .0329 4.54	+.1311 ± .0331 3.96	+.0971 ± .0333 2.91	+.1555 ± .0328 4.74
	Summer	+.0727 ± .0335 2.17	+.0607 ± .0335 1.81	+.0625 ± .0335 1.86	+.1042 ± .0333 3.12	+.1054 ± .0333 3.16
	Autumn	+.1064 ± .0333 3.19	+.0762 ± .0334 2.28	+.1043 ± .0333 3.13	+.2207 ± .0320 6.89	+.1759 ± .0326 5.39
	Annual	+.1078 ± .0332 3.24	+.1265 ± .0331 3.82	+.1315 ± .0331 3.97	+.2039 ± .0322 6.33	+.1962 ± .0323 6.07

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[1] Harris, J. Arthur, and Lewis, H. R., "The 'winter cycle' in the fowl," Science, N. S., 56: 230-231, 1922.

[2] Harris, J. Arthur, and Lewis, H. R., "Biometric considerations on the inheritance of fecundity in the White Leghorn fowl, *Poultry Science* (in press).

second year production of the mother and the first year record of the daughter is $r = 0.196 \pm .032$. While numerically small, these values are both positive and may reasonably be considered statistically significant.

The fact that there seems to be a significant correlation between the annual record of mothers and daughters at once raises the question as to whether the correlation is higher for the period of winter production, with respect to which the birds have heretofore been assumed to be differentiated in genetic constitution, than for the other "cycles."

We are now able to present the thirty-two coefficients measuring the relationship between the four individual "cycles" of the mother's first year and the daughter's first year, table 1, and between the mother's second year and the daughter's first year, table 2.

These coefficients are small throughout, and *individually would not be considered significant* in comparison with their probable errors. They are, however, preponderantly positive in sign and thus lend support to the conclusion that there is a sensible correlation between the records of mothers and daughters in the type of birds exhibited in contest flocks.

The most interesting feature of this series of results is the fact that the highest correlation is not that between the winter "cycle" of the mother and the winter "cycle" of the daughter, but between the autumn "cycle" of the mother and the autumn "cycle" of the daughter. Thus for the winter "cycle" of the mother's first year and that of the daughter's first year the correlation is + .139 as compared with + .199 for the autumn "cycles." The relationship between the winter "cycles" of the mother's second and the daughter's first year is measured by a coefficient of $r = + .058$ as compared with $r = + .221$ for the autumn "cycles."

This result for inheritance substantiates the conclusions drawn from our earlier studies of inter-annual correlation for the first and second laying year of the same individual.

J. Arthur Harris
Harry R. Lewis

Station for Experimental Evolution
and New Jersey Agricultural Experiment Station

THE UTILIZATION OF ATMOSPHERIC NITROGEN BY SACCHAROMYCES CEREVISIAE

A note on some of the results obtained in this laboratory in the course of studies on the nutrition of yeast may be of interest especially in view of the recent communication to this journal by Lipman and Taylor.[1] These authors claim to have proved the utilization of atmospheric nitrogen by the wheat plant. We have been working for a considerable time in this laboratory on the development of the simplest possible medium that will support the continued growth of yeast, and some of the data have a direct bearing on the utilization of atmospheric nitrogen by the organism.

Zikes[2] and DeKruijff[3] claimed that certain Torula can fix nitrogen. Kossowicz[4] stated that certain yeasts could fix nitrogen but later[5] reversed his opinion. Linder and Newman[6] could observe no nitrogen fixation by yeast. Mulvania[7] concludes that some yeasts can use atmospheric nitrogen. His data are qualitative in nature and he made no attempt to dilute out by subculture any nitrogenous compounds originally present in the yeast.

The yeast used in our work was plated out from a Fleischmann yeast cake and is known as *Saccharomyces Cerevisiæ* Race F. The cultures used in the experiments hereinafter described had been subcultured for three years at 30° C. in Medium E developed by Fulmer, Nelson and Sherwood.[8] The medium contained the following per 100 cc.: 10 grams of cane sugar, 0.188 grams of ammonium chloride, 0.100 grams of dipotassium phosphate, 0.100 grams of calcium chloride. The yeast had then been subcultured for six months in Medium C (2) which contained per 100 cc. the following: 10 grams of cane sugar, 0.188 grams of ammonium chloride, 0.100 grams of dipotassium phosphate. Yeast so grown furnished an ash free from calcium or magnesium. While the growth in Medium C was not as rapid as in Medium E the yeast continued vigorous and normal in appearance. The yeast undergoes no deterioration even after two years of growth in this medium.

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[1] Science, lvi, 605 (1922).

[2] *Sitzungsber, K. Akad. Wiss (Vienna) Math. Naturw. K.*, 118, 1091, (1909).

[3] *Ann. Jard. Bot. Butten. Zorg. Sup.*, 3, Pt. 1, 93, (1910).

[4] *Z. Garungsphysiol.*, 1, 253, 5, 26.

[5] *Biochem. Zeit.*, 64, 82.

[6] *Wehnschr. Proc.*, 30, No. 47, 589, (1913).

[7] *Bulletin* 122, Ag. Exp. Station, Univ. of Tennessee.
Chem. Abt., Vol. 15, 2291, (1921).

[8] *Journ. Amer. Chem. Soc.*, xliii, 191, (1921).

The yeast so obtained was inoculated into a series of flasks containing per 100 cc. of medium: 10 grams of cane sugar and varying amounts of dipotassium phosphate. In all experiments the temperature maintained was 30° C. There was a distinct optimum at a concentration of 0.45 grams of dipotassium phosphate per 100 cc. This optimum maintained during subculture. The above concentration then was adopted as standard. Conductivity water was used as the solvent. The medium was sterilized under pressure. While still hot, rubber stoppers were inserted, carrying two glass tubes through one of which air was bubbled through the medium, the other tube serving as outlet. The medium was cooled while being aerated with air from which all ammonia and nitrogen oxides had been removed by passing the air through acid and through alkaline potassium permanganate. A sterile medium which had been aerated under the same conditions as the growing culture showed considerably less than one part of ammonia or of nitrites or of nitrates per million parts of medium. The yeast grows nearly as well in this ammonia free medium as it does in Medium C. The cells are normal in appearance and appear to be in an excellent state of nutrition.

These results bring out two points of interest:

(1) The fact that yeast will grow continuously in a medium composed of sugar and one salt. (Pyrex flasks were used which had undergone several hundred sterilizations. We have not as yet made any correction for materials dissolved from the glass.)

(2) *Saccharomyces Cerevisiæ* will grow in an apparently good state of nutrition using atmospheric nitrogen as the sole source of that element.

It may be that the benefits accruing from the aeration of yeast cultures is as much due to the addition of nitrogen as of oxygen.

ELLIS I. FULMER

IOWA STATE COLLEGE,
JANUARY 26, 1923

THE AMERICAN CHEMICAL SOCIETY

(Continued)

PHYSICAL AND ORGANIC CHEMISTRY

SECTION II. COLLOIDS

Standardization in the grading of glue: **ROBERT HERMAN BOGUE.** So-called standard tests are being developed by the National Association of Glue and Gelatin Manufacturers (*cf.* Alexander, "Glue and gelatin," p. 225). This is to be commended, but the results will necessarily be prejudiced so long as manufacturers only are represented on their committees. A joint committee of manufacturers, consumers and independent experts is obviously necessary for actual and profound progress. Of particular significance is the *arbitrariness* of most or all of the specifications "agreed upon" by the association. Thus, concentration, temperature and procedure are defined by a compromise between extremes in "present practice" instead of by the only sound method—the determination by systematic investigation of the conditions which most accurately evaluate in terms of a fundamental property. Additional data on the use of the MacMichael viscosimeter in the determination of a fundamental property of glues and the conversion of these data to absolute units are given. The use of a pipette type of viscosimeter is discussed and some data bearing on its application and calibration in absolute units are presented.

The action of salts on hydrous cupric oxide: **HARRY B. WEISER.** Hydrous cupric oxide adsorbs ions strongly. If shaken with solutions of neutral salts, like NaCl or Na_2SO_4, hydrolysis takes place and the solution becomes distinctly alkaline, owing to stronger adsorption of acid than of base. On account of this strong adsorption, the presence of certain salts may accelerate the spontaneous loss of adsorbed water. The hydrous oxide may be heated to 100° without darkening in the presence of very small amounts of salts, such as $MnSO_4$, $CoSO_4$, $Al_2(SO_4)_3$, $Cr_2(SO_4)_3$, $ZnCl_2$ and $CuCl_2$. It has been demonstrated that the absence of darkening is not due to stabilization by adsorption of the hydrous metallic oxides as suggested by Bancroft and reaffirmed by Blucher and Farnau; nor to the formation of basic salts as suggested by Spring and Lucion. The explanation is to be found in the change in physical character from the highly gelatinous to the granular form of the oxide. Only those salts which hydrolyze appreciably giving H-ion are effective in low concentrations, since the slight solvent action of the H-ion destroys the gelatinous structure, and the denser granular modification which forms loses water and darkens less readily than the looser gelatinous mass.

The formation of inorganic jellies: arsenates: **HARRY B. WEISER and ALLEN P. BLOXSOM.** Grimaux has shown that the dialysis of a colloidal solution of ferric arsenate peptized by ferric chloride results in the formation of a jelly. This has been confirmed by Holmes. The latter finds that the dialysis removes acid and points out that the same result may be obtained by decreasing the H-ion concentration by allowing ammonia or sodium acetate to diffuse through parchment into the colloid. Ferric arsenate peptized by ferric chloride or HCl gives a positive colloid stabilized by preferential adsorption of hydrogen ion. Dialysis lowers the concentration of the peptizing agent below the critical value so that slow coagulation takes place—an important condition for the formation of a stable jelly. The same result may be obtained by suitable addition of an electrolyte having a strongly adsorbed anion. The important thing is to neutralize the adsorbed H-ion which gives the colloid its stability rather than to cut down the actual H-ion concentration in the solution, as Holmes implies. This is established by the observation that jellies are formed by the coagulation of positive colloidal ferric arsenate with acids, such as H_2SO_4 and H_3PO_4, H_2CrO_4 and citric and by any number of so-called neutral salts. Similar results were obtained with ferric arsenate colloids stabilized by hydroxyl ion and with colloids of other arsenates. The results are in accord with the author's general theory of the formation of inorganic jellies.

The viscosity of gelatin solutions: theoretical considerations (lantern): **STERNE MORSE.**

The viscosity of gelatin solutions: the influence of electrolytes (lantern): **STERNE MORSE.** (1) If the fluidity of a mixture is taken to be an additive function of the fluidities of the components when the latter are taken in terms of their molecular concentrations, and if it is assumed that there exists in a gelatin solution containing a salt two forms of the dissolved gelatin, differing in viscosity, the one reacting reversibly with the salt to form the other, an equation can be derived from these assumptions which satisfactorily fits the observed data. This equation has the form:

$$xn = k\frac{a - v}{v - b}$$

where v is the observed viscosity of the system, x is the concentration of the salt, and n, k, a and b are constants. a is nearly equal to the limiting value of v where the amount of electrolyte approaches o and b is nearly equal to its limiting value where the amount of electrolyte is made large. The equation is only valid where the hydrogen ion concentration does not change. (2) If the hydrogen ion concentration changes all these constants change for a given salt. The constant a is shown to vary according to the empirical equation:

$$\frac{(p_H - p)'}{c} - (A - a)^n - k$$

where c, n, A and k are constants and where p is a constant, nearly equal to 3.0. (3) The viscosity of water is shown not to enter into the above equation if the amount of free water remains constant or is very small. The hypothesis is therefore advanced that the amount of free water in systems of this nature is very small as the preferable alternative. This is held to explain the very large effect of the presence of gelatin on the viscosity of its solutions. (4) The constants of the first equation are shown to exhibit *maxima* or *minima* in the neighborhood of the hydrogen ion concentration, $p_H = 3.0$. The importance of this point of acidity is further shown by the fact that the value of p in the second equation is usually or always in this neighborhood. (5) The limiting value of the viscosity in the presence of large concentrations of salts is dependent on the value of the cation in acid solutions, and for the salts tested appears to follow the ability of the cation to associate water.

Experiments on the swelling of ash-free gelatin: **S. E. SHEPPARD, FELIX A. ELLIOTT AND ANBER J. BENEDICT.** Two phases of the swelling of ash-free gelatin have been investigated conjointly; the effect of variations in the hydrogen ion concentration on swelling, with the effect of previous treatment on swelling. It was found that in ash-free gelatin swollen in buffered solutions of varying p_H's at 7°C. a minimum swelling takes place over a region centered at p_H 4.8, or the iso-electric point of gelatin, and swelling increases both with increasing and decreasing hydrogen ion concentration. This is in disagreement with Wilson and Kern, who found a second minimum at $p_H = 8$. It is believed that their observations may have been due to the presence of (1) other proteins not present in ash-free gelatin or (2) the presence of ash, *i.e.*, inorganic salts combined or otherwise. Experiments have also been made with sheets of gelatin of varying thicknesses dried from a solution of given concentration and with sheets of uniform thickness dried from solutions of varying concentrations. The results establish a definite effect of these factors on the swelling limit, which indicates that modifications of the Proctor-Wilson-Loeb theory of swelling are necessary.

Note on formation of a carbon gel in tar: S. E. SHEPPARD and L. W. EBERLIN. In the course of development of colloidal fuels considerable quantities of the residual "pressure still" tar from Burton stills was obtained and used. This residuum had the following properties: viscosity Engler, 7.3 at 20°C.; flash point, 290° F.; asphaltum, 4.6 per cent.; free carbon, 1.0 per cent. These figures are representative, the values fluctuating with different lots. The point of interest in the present connection is the behavior of the "free" carbon. This is present in the original tar as submicroscopic particles, which on dilution with benzine show for some time lively Brownian movement. There is some tendency on prolonged standing for the asphalt and carbon to sludge, but what is more remarkable is that on standing for a year or more—in the present case examination was made after three years—the "free" carbon had aggregated to form a semi-rigid gel, uniformly dispersed throughout the oil, although starting at the bottom and sides. The whole gel was easily broken up mechanically, but had a distinctly "gritty" feel; it appears evident that this slow coking produces a product similar in character to the normal petroleum coke from the still, but in this case gradually built up. The faculty of carbon atoms of building up chains and networks, postulated by I. Langmuir in connection with the structure of adsorbent chars, seems well demonstrated here. Protective colloids delayed but did not entirely prevent this carbon gel formation. Analyses for free carbon did not show any noteworthy increase in its amount.

The preparation of highly absorbent gels: HARRY N. HOLMES and J. ARTHUR HENDERSON. The authors slowly added a solution of ferric chloride to a water glass solution (very definite volumes and concentration). The deep yellow gelatinous precipitate was washed, dried, then activated at 145°. At 30° it absorbed 31 per cent. of its own weight of benzene from a stream of air saturated with benzene. A precipitate dried at 50° until hard before washing gave a gel of 43.1 per cent. absorptive power. A similar gel dried hard and then soaked with dilute HCl to convert the iron oxide into chloride was washed and activated. It adsorbed 49.3 per cent. benzene. This was white silica gel. The product purchased from the Silica Gel Corporation adsorbed 33 per cent. benzene.

Adsorption by activated carbon—theory of hydrolytic adsorption: F. E. BARTELL and E. J. MILLER. From our work on adsorption of electrolytes by activated carbon, we have been led to the view that the adsorption is hydrolytic in nature. The theory of adsorption is based upon recent work of Bragg and Bragg on crystal structure and work of Langmuir and Harkins on orientation of molecules in liquid surfaces. Solid carbon is assumed to have a crystal lattice resulting in adsorption points. Through the operation of residual forces from these points hydroxyl and hydrogen radicals are adsorbed; the former may be displaced by almost any anion, the latter only by cations of metals more electropositive than hydrogen. Radicals containing carbon groups readily displace H or OH radicals, *i.e.*, they are readily adsorbed. Introduction of CH_2 groups. Additions of polar groups as COOH, OH, $CONH_2$ decreases the adsorption. This theory accounts for the results obtained in the adsorption of acid and basic dyes by charcoal.

The adsorption of ammonia by metals: HUGH S. TAYLOR, ARTHUR F. BENTON and WALTER A. DEW. Ammonia is reversibly adsorbed by copper to a large extent in the temperature region 0°—218°C. It is adsorbed by iron, largely irreversibly, hydrogen first predominating and then nitrogen being pumped off on heating the iron-ammonia complex. With sodium, as is well known, sodamide is formed, doubtless preceded by a $Na\text{-}NH_3$ complex. The bearing of these observations on contact catalysis, on specificity of catalytic action and on catalytic mechanism in the light of newer theories of atomic and molecular structure will be discussed.

A quantitative study of the effect of the hydrogen-ion concentration in electric-endosmose work: J. W. ELDER and NEIL E. GORDON. A quantitative study of electric-endosmose was taken up with aqueous solutions of varying hydrogen-ion concentration, using silica gel as the membrane. It was found that the change of the charge on the membrane had nothing in common with the neutral point. The relation of the charge on the gel to the p_H value of the solution was also studied in the presence of salts, and the cation and anion effects noted.

Plasticity in colloid control: EUGENE C. BINGHAM and ALFRED G. JACQUES. The concentration of zero yield value and the concentration of zero mobility are characteristic properties in non-polar colloids, which are closely connected with the size and shape of the colloidal particles. Both of these properties are found to be independent of the fluidity of the medium. The effect of small percentages of impurities as well as the length of time in grinding in the process of mixing have been measured.

CHARLES L. PARSONS,
Secretary

SCIENCE

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Science News x

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COOPERATION BETWEEN THE MAKERS AND USERS OF SCIENTIFIC APPARATUS IN AMERICA[1]

ALMOST exactly one year ago these two societies met upon a similar occasion for a joint dinner, following which there were presented several invited papers in which were discussed the importance of scientific apparatus in research, the good which might result from closer cooperation between the makers and users of apparatus and the lines along which such cooperation might take place. As a result of this discussion there was passed by the joint meeting a resolution urging the councils of the two societies to request the National Research Council to call a conference of representative makers and users of scientific apparatus at some convenient time during the forthcoming year.

In part as a result of this resolution the National Research Council called together early in January of the present year a small group for the purpose of discussing the desirability of calling a larger conference and of making arrangements therefor if such a larger conference seemed desirable. A very short discussion at once convinced those in attendance at the preliminary meeting that the larger conference was desirable. Accordingly the National Research Council through its division of research extension issued invitations to some eight different scientific societies and several government and semi-government departments to send representatives to such a conference to be held in Washington, March 23 and 24, 1923.

We are now met for the second annual joint dinner and it is appropriate upon this occasion to recount the results of the conference held about one month ago.

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[1] Presented at the joint dinner of the American Physical Society and the Association of Scientific Apparatus Makers of the United States of America in Washington, April 20, 1923.

When the conference convened in the conference room of the National Research Council at 10:00 A. M., March 23, those who had been influential in calling the conference were very much gratified to find an attendance of nearly one hundred per cent. All but one or two of the original thirty or thirty-five persons invited either were present or sent substitutes. This large attendance seemed at once to answer the question which had frequently been raised: is such a conference worth while? The fact that thirty men were sufficiently interested to leave their busy offices and to spend two days in Washington discussing the American apparatus industry seemed to answer the question in the affirmative.

The conference was called to order by Mr. W. M. Corse, chairman of the division of research extension of the National Research Council. Dr. Vernon Kellogg, permanent secretary of the National Research Council, was introduced and in a few well-chosen words welcomed the conference on behalf of the Research Council and pointed out that such activities were quite in harmony with the ideals of the Council in furthering research. Following Dr. Kellogg's address Dr. George K. Burgess was elected permanent chairman of the conference. The success of the conference was due not a little to the skill of the chairman in encouraging discussion and in introducing the informality of a round table.

The program, as prepared in advance by the preliminary committee, was made up of four parts: (1) apparatus supply; (2) standardization of apparatus; (3) information service; (4) inspection service. It would, of course, be impossible at this time to give even a summary of the various papers and discussions. The stenographic reports of the conference cover some fifty single-spaced typewritten pages. But a few remarks may be made with regard to several of the papers in order to indicate some of the more important points brought out and discussed.

The first paper was by Mr. Walter Eimer on the importation of scientific apparatus. Mr. Eimer pointed out that previous to 1874 practically all scientific apparatus was imported. About that time, however, there was a desire for better service and for greater accessibility of supplies. As a result of this agitation the American apparatus industry was started. But as late as 1913, eighty per cent. of the total supplies and equipment needed in certain lines was being imported. The beginning of the European war greatly increased the demands which the American user made upon the American maker of apparatus. The maker of apparatus, however, in spite of difficulties in securing capable workmen and in getting the necessary raw material, rose to the occasion and in 1921 only five to eight per cent. of supplies in these same lines were being imported. At the present time manufacturing houses are adding one line after another with a consistent improvement in quality. In some cases the quality is superior to that which was formerly imported. For example, chemical glassware now available in this country has no equal in the European markets. Recent tariff legislation has resulted in preventing a European monopoly and in view of healthy competition does not seem likely to result in a monopoly in any line in this country.

The question of domestic apparatus manufacture was discussed jointly by the present speaker and Mr. M. E. Leeds. It was pointed out that the uses of apparatus may be divided into three main groups. First, apparatus required for instruction; second, for research; and third, for testing and control in industry. Apparatus intended primarily for instruction, whether for lecture or laboratory work, should be neat and attractive, should have the appearance of careful designing, but need not have the high precision required in research. For research, on the contrary, appearance is secondary while precision is a primary requisite. It was pointed out that it is desirable to develop a line of apparatus primarily intended for the individual demonstration of some of those phenomena in physics and chemistry which can not be demonstrated to a whole class and which nevertheless are of such a kind as can not be readily studied in the laboratory with the limited time available to the majority of students. Mr. Leeds spoke of domestic apparatus from the manufacturer's standpoint. The keynote of his talk may be indicated by the following quotation: "If we depend on foreigners for the development of our apparatus we shall always be copyists and shall be one jump scientifically behind those from whom we buy." Not only is it important from the standpoint of our scientific work that we should develop our own methods and apparatus, but it is important that the manufacturer from his standpoint should cooperate in developing such new apparatus, since it frequently happens that a special laboratory instrument in a short time becomes a standard laboratory instrument for many types of measurements, or even an essential tool of a great industry. There is reason, therefore, for the closest cooperation between the maker and user of apparatus.

The subject of the instrument shop of the research and college laboratory was discussed by Dr. W. D. Collins. Dr. Collins pointed out that the laboratory shop could usually justify its existence because of the necessity in research and instruction for making repairs or special apparatus in a hurry and that in the construction of new apparatus it had the great advantage of bringing about personal contact between the designer and the maker, rendering unnecessary the rather expensive laborious task of making drawings, blue prints, etc.

The final paper on apparatus supply was by Dr. H. E. Ives on the subject of the manufacture of special apparatus not now made in the United States. Dr. Ives pointed out that a very great many of our most important pieces of apparatus for instruction and for research have originated abroad, as is indicated by the frequent use of foreign names in connection with instruments. Thus we have the *Lummer-Brodhun* photometer; the *Bragg* X-ray spectrometer; the *Dolezalec* electrometer. Although there are some pieces of apparatus bearing American names, nevertheless one is almost justified in concluding that there are more scientific ideas in Europe than in America, the moral of which fact being obviously of joint interest to makers and users of apparatus. The difficulties of manufacturing in America some of the special apparatus needed are very great. Among them may be mentioned such items as scarcity of skilled labor, high labor costs and the general tendency in America to quantity production. We ought, however, to originate more apparatus here and to cultivate a better respect for instruments and a better understanding between those who make them and those who use them.

The subject of standardization of apparatus proved unexpectedly interesting to those who had not given particular thought to this question. The first paper in this group was by Mr. J. M. Roberts on "Limitations of types and sizes." A systematic effort has been made by the makers of and dealers in chemical glassware and supplies, cooperating with the American Chemical Society and other users, toward the standardization of sizes and dimensions for the purpose of eliminating the large number of comparatively little used items and sizes. By means of a questionnaire it was found that a fairly large number of makers and users would agree upon certain eliminations. As an example of what was accomplished, in the catalogue of one supply house which listed one hundred forty-eight different types of gas burners, seventy were eliminated. Some of those eliminated had been designed fifty years ago. Out of two hundred twenty-seven items covering chemical porcelain, ninety-nine were eliminated. One hundred twenty-three out of one hundred ninety different forms of gas analysis apparatus were dropped; one hundred seven out of one hundred ninety-nine sizes and kinds of funnels. In all, the committee in charge of this work eliminated some eighteen hundred out of thirty-two hundred items without in any way restricting methods either in instruction or research. More difficulty was experienced in the standardization of physical apparatus. But even here a careful study made it possible to eliminate some six hundred fifty sizes and designs out of two thousand items listed. Mr. Roberts reported that the work was being continued and that the apparatus makers were cooperating with and would welcome further suggestions from the educational committees of the various scientific societies interested.

It is unnecessary to comment extensively on the importance of this study which Mr. Roberts and his associates have made. The savings as a result of economy of manufacture and of reduction in capital tied up in supplies are being passed on to the consumer in the shape of reduced costs. Already one manufacturer has announced reductions of from ten to twenty-five per cent. in net prices.

Mr. H. C. Dickinson discussed the standardization of parts on the basis of the experience of the automotive industry, as an illustration of what might be done along, of course, somewhat different lines in connection with scientific apparatus. Mr. Dickinson pointed out that largely through standardization of parts and of methods a Ford car costs a very small sum to build, whereas were an engineer to start out from the beginning it would cost at least one hundred thousand dollars per car. In the automotive industry this standardization of parts has been accomplished without in any way restricting the designer. Similar standardizations could be made in scientific apparatus without restricting the scientist as to method or choice of apparatus.

Dr. G. K. Burgess spoke on standardization of method of measurement. If the eliminations in apparatus catalogs already noted have taken place without standardization of method, how much more might be accomplished if scientists could agree upon certain standards with regard to methods of measurement.

The subject of information service was discussed by Mr. Boulton Earnshaw, Dr. W. E. Tisdale and Mr. M. E. Leeds. Mr. Earnshaw pointed out from the standpoint of the purchasing agent the desirability of readily accessible sources of information as to where various supplies and pieces of apparatus could be obtained. One difficulty which he mentioned was the location of manufacturers of certain rare chemicals. Dr. Tisdale spoke of the Research Information Service of the National Research Council and stated that the Council was very glad to be of assistance in this connection. Mr. Leeds discussed the importance of scientific bulletins concerning the use of apparatus and stated that very frequently such bulletins prepared by manufacturers had actually been used for class purposes.

The final topic, inspection service, was discussed by Dr. E. W. Washburn, who stated that manufacturers of apparatus could perform a very valuable service to users by sending around well trained inspectors who could adjust special apparatus or make simple repairs. Frequently such a skilled repair man could do in a few moments what would take the laboratory mechanician several hours to do even though the apparatus did not have to be sent back to the factory for repair.

Perhaps the most important part of the meeting, as well as in some ways the most interesting, was the general discussion at the third half-day's session, March 24.

Those of us who had the privilege of attending the conference were convinced that our time was well spent and that we were amply repaid individually for our efforts. But we of course represented actually only a small number of users and makers and the question may well be raised, what was the value of the conference to American scientists and to the American apparatus industry in general. Was it simply another activity interesting enough in itself, but of no possible permanent or general value? The answer to these questions depends largely upon one's viewpoint.

The first and most important thing in my mind with regard to the conference is the simple fact that it *was* held. For the first time a group of makers and users of apparatus gathered together for a common purpose to discuss problems in which they are mutually interested. Whatever may be the outcome of this movement the simple fact is that this conference marks its beginning. If the solution of any problem is half completed when the problem is clearly stated, it is certainly true that an important step in the solution of any problem is the recognition of its existence. The conference discussed many things. And there can be no question but that the problem of closer cooperation between makers and users is an important one, whatever further work may be done in this direction.

Closely associated with this simple fact that the conference was held is a group of rather intangible results likewise of most importance to those of us who had the privilege of attending. Some three dozen men representing all branches of the apparatus industry and of research and pedagogical interests met each other, became more or less acquainted and came to have somewhat of an appreciation of each other's problems. The inevitable result of such contacts is to develop a spirit of tolerance and of good will. If we think that the bill which is rendered us for apparatus or supplies is a little too large we have only to keep in mind the fact that apparatus makers have no subsidy, that they must run their business with a reasonable margin of profit in order that they may be able to undertake some of the newer developments which so many of us users desire. If the General Electric Company, for example, had not made money from its business and had not had the foresight to spend that money in research the whole world would not now be enjoying the economies which come from the use of the tungsten lamp. Could we have foreseen the immense value to civilization of the tungsten lamp it would have been commendable for the United States government to have spent a million dollars for research in this direction. We can see it all very clearly now, for our "hindsight" is always better than our foresight. And I feel confident that fifty years from now scientists can look back upon the present decade and the two or three following and point out the value of cooperation between makers and users of apparatus. It perhaps requires some courage now to think that the movement is worth while and is likely to produce tangible results.

To offset the indefiniteness of some of the results of this conference, valuable as those results are, certain steps were taken which are somewhat more tangible. It was realized at the outset that the conference would fail utterly if its influence were felt only by the few who attended. Accordingly there was passed by the conference a resolution requesting the National Research Council to form a permanent committee to be known as the "Committee of apparatus makers and users" which should consist of representatives (one or more as indicated) from the following technical societies and organizations: American Chemical Society, American Physical Society, American Ceramic Society, American Institute of Electrical Engineers, Optical Society of America, American Electrochemical Society, Manufacturing Chemists Association, American Society for Testing Materials, Bureau of Standards (two representatives), Association of Scientific Apparatus Manufacturers of the United States of America (six representatives) and additional members at large to be appointed by the committee itself. It was suggested that there should be formed an executive committee of the main committee, which should consist of seven members selected by the main committee. It would be the duty of this executive committee to initiate such projects as might be suggested by the several members of the larger committee or by others interested. The executive committee subsequently added the Society of Automotive Engineers and the American Society for Steel Treating to the list named above. It is proposed to have a meeting of the large committee once a year, which meeting should discuss the general question of apparatus manufacture and use and which should be open to all interested.[2]

Among the questions which doubtless will come up for discussion and which may result in the initiation of important problems of a cooperative nature may be mentioned the question of facilities for making special apparatus, further standardization of apparatus and supplies, the development of an inspection service and the like.

It is to be hoped that all of those interested directly or indirectly in American science, whether from the standpoint of actual users of apparatus or from the standpoint of those who profit financially or otherwise from scientific research, will heartily support this movement to build up a strong apparatus industry in America to the end that American science may be strengthened. Those of us who are interested in this movement are not thinking of the question from the standpoint of narrow patriotism, for a scientific fact is just as valuable to the civilized world whether discovered in America or in Europe. But we do feel that American science, just like the American citizen, has an individuality and an independence which, from the standpoint of our contribution to world service, we can well afford to cultivate.

F. K. RICHTMYER

CORNELL UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SUMMARY OF THE PERMANENT SECRETARY'S SEMI-ANNUAL REPORT, MARCH 31, 1923

THE work of the association has proceeded satisfactorily during the first half of the fiscal year 1923. The relations of the association with the two divisions and with the State College (Pennsylvania) Local Branch, as well as the affiliated academies, have been continued as usual. Information regarding membership is shown in the following tabulations:

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[2] The National Research Council announces that through its division of research extension it has formed the Committee of Apparatus Makers and Users essentially along the lines of the resolution passed by the conference.

MEMBERSHIP IN THE A. A. A. S., MARCH 31, 1923

Sustaining members		3
Life members:		
Pacific Division	32	
Southwestern Division	3	
Rest of Association	334	
Total		369
Annual members in good standing:		
Pacific Division	1,036	
Southwestern Division	106	
State College Branch	54	
Affiliated Academies	1,328	
Rest of Association	7,348	
Total		9,872
Annual members in arrears for 1922 and 1923:		
Pacific Division	65	
Southwestern Division	20	
State College Branch	3	
Affiliated Academies	58	
Rest of Association	333	
		479
Annual members in arrears for 1923 only:		
Pacific Division	129	
Southwestern Division	35	
State College Branch	3	
Affiliated Academies	123	
Rest of Association	677	
Total		967
Total of names on roll		11,690

CHANGES IN MEMBERSHIP DURING FIRST HALF-YEAR, 1923

Gain in membership:		
Reinstatements	13	
New members (4 life, 770 annual)	774	
Total gain		787
Loss in membership:		
Dropped October 1 last for non-payment of dues	455	
Resignations	217	
Deaths	71	
Total loss		743
Net gain		44
Transfers from annual to life membership		19

SEMI-ANNUAL RECORDS OF MEMBERSHIP SINCE SEPTEMBER 30, 1920

	In good standing	Total enrollment
September 30, 1920	10,002	11,442
March 31, 1921	9,637	11,524
September 30, 1921	10,160	11,547
March 31, 1922	9,911	11,652
September 30, 1922	10,566	11,646
March 31, 1923	10,224	11,690

The membership is being maintained and slightly increased each year. Payments of annual dues are becoming much more prompt. Life memberships have increased in number very satisfactorily this year. Since last October 1, 23 new life members have been enrolled, 19 of these representing transfers from annual to life membership. It is hoped that members will increasingly realize the advantages of life-membership, to themselves as well as to the association, and that the number of life members will continue to increase.

The financial affairs of the association are in excellent condition. The work thus far undertaken is being adequately supported. It should be noted, however, that additional lines of activity for the advancement of science should be undertaken as soon as the finances will permit. And there are many ways in which the work of the association might be extended.

Preparations for the Los Angeles meeting next September are progressing very well indeed, owing to the efficient work of Mr. W. W. Sargeant, secretary of the Pacific Division, and to that of the general secretary, Dr. D. T. MacDougal. A preliminary announcement of the meeting will be sent to all members. Correspondence regarding the meeting should be addressed to Mr. W. W. Sargeant, Golden Gate Park, San Francisco, Calif.

The local committee for the third Cincinnati meeting has been organized, with Dr. Louis T. More as chairman, and much of the preliminary work has already been completed. Each section of the association will have a local representative and the societies meeting at Cincinnati next December are asked to make all arrangements for their sessions through the local representatives of their respective sections.

BURTON E. LIVINGSTON,
Permanent Secretary.

GEORGE LINCOLN GOODALE
1839-1923

BOTANY, in America as elsewhere, owes much to men who acquired an interest in plants while studying medicine or who adopted the medical profession as affording a livelihood while permitting them to follow more or less seriously botany as an avocation. Howard Kelly has written a delightful series of biographic sketches of a few American physicians to whom botany was pleasure in the sense that it was what they paid for, while practice of their profession was work in the sense that it was what they were paid for.

Engelmann and Chapman are outstanding among Americans of this type: but Torrey, Gray, Farlow and Goodale mark the transition to the modern type of professional botanists, to whom this branch of science is at once vocation and avocation. Equipped with the means of practicing a remunerative profession, they found awaiting them the opportunity to break into the new profession of teachers of the science to which they were attached.

Not only in preparation but in successful practice, Dr. Goodale was a doctor in the sense in which an old-fashioned friend expressed himself to me nearly half a century ago as thinking of the word—a physician; or an elderly person to whose name certain letters of the alphabet have been appended by colleges in recognition of conspicuous service rendered the public; for in those days, on this side the ocean, men were only beginning to bear that stamp of academic approval that our great universities give annually now to hundreds of men who have prepared and defended a dissertation in some field of learning.

Though he lacked this modern prerequisite for even an instructorship in a worthy institution, Goodale from the first was a doctor literally and within the meaning of my friend; and in due time Amherst, where he had graduated, Bowdoin, where he first taught, and Princeton stamped with their approval his scholarship and public service. Even more indicative of such approval are the memberships accorded him in bodies like the National Academy of Sciences, the American Philosophical Society and the American Academy of Arts and Sciences; and offices such as the presidency of the American Association for the Advancement of Science, which he held in 1890.

Professorships in the sciences were not so minutely divided two generations ago as they are now. When, after three years of medical practice, Dr. Goodale entered the faculty of Bowdoin College in 1868, it was as a professor of natural science. Four years later his brilliant exposition of this group of sciences opened to him an instructorship in botany at Harvard, which developed quickly into an assistant professorship and a professorship—from the active duties of which he retired as professor emeritus fourteen years ago at the scriptural age of three score years and ten.

It is not without significance that with the title of instructor in botany his appointment at Harvard carried also that of lecturer on vegetable physiology. Asa Gray, the outstanding figure in American botany, whose contributions to the science were in the field of what is now called taxonomy, saw and understood and planned far beyond the limits of his own specialty; and the entry of Goodale and Farlow into the faculty of Harvard under President Eliot's fostering of the sciences gave to that great university prominence in this science fifty years ago.

Though I never had the privilege of study under Professor Goodale, I came into close personal contact with him in 1880, when I went to Cambridge for graduate work with Farlow, Hagen and Mark; and it was my privilege frequently to listen to his brilliant lectures, which I never have heard surpassed in his field. It was in his laboratory that I first saw—and used during the summers of 1883 and 1884 when at his request I took charge of the summer session in botany—the prototypes of the present-day auxanometers and klinostats; and with him more or less successfully constructed and applied the osmometers with which Wilson recently had shown talented manipulative skill in Pfeffer's laboratory.

Dr. Goodale was alert in framing unanswered questions and ingenious in devising means of answering them. If his contributions to botanical knowledge be not found numerous and important, perhaps explanation is to be found in the possession of those traits which lead a man to devote possibly productive time to over-careful detail preparation for what he is to present in the lecture-room rather than to the methodical but often discouragingly broken drudgery of investigation, at first hand, or with students whose names appear as authors of dissertations.

Professor Goodale was a genial man. Those who admired him had confidence in him. Commercial Boston had many a stipend for investigation or travel at his suggestion. Nowhere in the world is to be found a counterpart of the superb representation of our flowers in glass made by the Blaschkas under his direction as curator of the botanical museum of Harvard, with the financial backing of Mrs. Ware and her daughter. Those who really knew him loved him. Since the passing of Professor Gray, a generation ago, the memory of my infrequent visits to Cambridge has been brightened by contact with Professor Goodale and one or more of the enthusiastic unprofessional botanists who were his intimate friends and with whom he continued to share the curious interest in nature that is the foundation of most really serviceable work in botany, either didactic or productive; an interest of which the beginnings are to be found recorded here and there in herbarium specimens of choice Maine plants collected in the early days when he was called on to teach "natural science, mineralogy, botany and applied chemistry" at Bowdoin College.

William Trelease

University of Illinois
May 14, 1923

SCIENTIFIC EVENTS

MOTION PICTURE OF THE TOTAL ECLIPSE OF THE SUN[1]

There have been in the past several proposals to take a cinema film of a total eclipse of the sun, but the first real outcome of these proposals is the film now being shown at the Royal Albert Hall. The pictures illustrate the experiences and the work of the astronomers of the expedition, under Professor W. W. Campbell, to Wallal, on the northwest coast of Australia, from the time they left Perth until after the eclipse on September 21. The journey to Broome was made on the S.S. *Charon* and afterwards on the lugger *Gwendoline,* towed by a lighthouse tender, to Ninety Mile Beach. On account of the great rise and fall of the tides, the ship had to anchor five miles out, and the astronomers with all their baggage had to be landed in boats through the surf. The equipment was then transported on donkey wagons to the site selected for the camp and in this work the aboriginal inhabitants of the country, both men and women, gave considerable assistance. The large amount of dust, which rose in clouds wherever there was any work being done, caused great inconvenience. Nevertheless a large camp was soon set up and the assembling of the instruments commenced. The process of erection of the tower telescope and of the equatorials aud cœlostats, as well as the various rehearsals in changing plates and uncovering object-glasses, are well illustrated. The part of the film showing the solar corona is good, considering that it was taken with a cinema lens, but a better picture could easily be constructed from the negatives taken by the eclipse party.

The film will enable those who are interested in scientific work to appreciate the difficulties which eclipse observers often have to face. Large and cumbersome instruments have to be transported long distances and often erected in almost inaccessible places where little or no skilled labor can be obtained. The conditions at Wallal were probably more difficult than usual, but were bravely faced and overcome. A wireless apparatus was erected to keep the eclipse party in communication with the outside world and a weekly aeroplane service was instituted. The film is well worth seeing by those interested in the work of scientific expeditions. It would have been too much to expect that a film of this kind, taken under such difficult conditions, would come up to the standard of films produced by special actors in artificial conditions. However, the fact that the actual work of the astronomers is interspersed with pictures illustrating the life of the natives should make the film one of more general interest. With these additions the showing of the film takes a little over an hour. The attempt to produce a film showing the actual work of a scientific expedition is one which deserves every encouragement and we wish it every success.

CANADIAN STATIONS IN THE ARCTIC

The *Royal Geographical Journal,* quoting from the annual report for 1921-22 of the Royal Canadian Mounted Police, gives details of the progress lately made towards the establishment of fixed administrative stations in the Arctic Islands over which the Dominion exercises control. The previous report had described the establishment of the police detachment at Ponds Inlet, one of three posts which it was intended to establish, the plan being to place the other two on North Devon and Ellesmere islands respectively. In July, 1922, the C.G.S. *Arctic*, Captain Bernier, sailed from Quebec with Inspector Wilson—a commissioned officer—and eight other ranks of the police, the Department of the Interior being represented by Mr. J. D. Craig. She carried building materials and stores for two of the posts, those for the North Devon post being left to be taken north in 1923. The entrance to Ponds Inlet was reached on August 15, but, pack-ice making it impossible to enter, the *Arctic* proceeded to Jones Sound. Ice likewise blocked Fram Fiord, on the south coast of Ellesmere Island, which had been chosen as the site of the post; but a fairly suitable place was found on the shore opposite Smith Island and here Inspector Smith decided to winter, the landing of stores being completed after hard work on August 28. The spot has been named Craig Harbor and here the inspector remains with one non-commissioned officer and five constables. A postoffice has been established, but it can hardly be expected to function for any large part of the year. As the headquarters of the three northern detachments it is thought that Dundas Harbor on the south coast of North Devon offers the best advantages, Lancaster Sound being usually clear of ice for a longer time than Jones Sound. The stores, etc., for Ponds Inlet were landed on the return voyage early in September, access to the post being still much hampered by ice. From the west of Arctic Canada it is reported that the headquarters of the "Arctic" Sub-district are being removed from Herschel Island to Aklavik in the Mackenzie delta, which has of late become the trading center of the district. Fort Macpherson is being abandoned, while the Tree River detachment is being strengthened and a new detachment will be established at Cambridge Bay, on the south coast of Victoria Island, about two hundred miles from Tree River, itself a very remote post. The report states that in April, 1922, a patrol visited Mr. Knud Rasmussen's camp on an island near Melville peninsula.

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[1] From *Nature.*

THE CONGRESS OF THE GERMAN SOCIETY FOR INTERNAL MEDICINE[1]

THE German Society for Internal Medicine, which meets every two years in Wiesbaden, has arranged to hold its meeting every alternate year in another large German town and Vienna was chosen for this year. Professor Wenckebach organized the convention. More than 1,400 physicians took part in the proceedings, including visitors from northern Europe, Asia, Italy and the New World, so that this meeting was really international, the first of its kind in Vienna since 1913. The proceedings were grouped under three heads: (1) epidemic (lethargic) encephalitis; (2) hypertension and (3) internal secretion. Two eminent men were asked to give an introductory report on each of these subjects, one dealing chiefly with the anatomic or physiologic, the other with the clincial side of the problem.

In connection with the congress, an exhibition of the latest achievements of chemistry, electrotherapeutics and medical technic was opened, in which the changes brought about by these factors in the medical armamentarium were well illustrated. The blood pressure apparatus, the microscope, the fluoroscope, the roentgenogram and metabolimeter are now indispensable and ready-made pills and hypodermics are always at hand.

The scientific program was carried out in magnificent surroundings in the reception hall of the former emperors of Austria, which was selected and adapted for the purpose. The municipality of Vienna and the president of the republic gave receptions in honor of the guests, and social gatherings and excursions to neighboring watering places and health resorts in the Alps served to relieve the sober work of the convention. The scientific proceedings lasted from April 9 to 12, with Professor Wenckebach in the chair. As a large number of papers and reports were presented, with the exception of the introductory papers, ten minutes was allowed for each paper and discussion was limited to four minutes.

EXPERIMENTS ON LIVING ANIMALS

AT the fifth annual stated meeting of the American Society of Mammalogists, held May

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[1] From the *Journal of the American Medical Association.*

15 to 17, 1923, in the Academy of Natural Sciences, Philadelphia, Pa., the following resolution was adopted:

Whereas, it is a fact known to all thinking people that most of the great advances in medicine and surgery have been made as a result of experiments on living animals, especially mammals, and

Whereas, it is the belief of our eminent physicians, surgeons and veterinarians and all others having great responsibility for the health of human beings and of animals, that future advances in these fields will be made chiefly as the result of similar experiments, and

Whereas, it is known that these experiments almost invariably are conducted humanely and with a minimum of discomfort to the animals used, and

Whereas, there is an organized movement being carried on by certain misinformed and misguided individuals who seek to prevent or seriously interfere with such experiments;

Be it resolved, that we, members of The American Society of Mammalogists, in annual convention assembled in the city of Philadelphia, on the sixteenth day of May, 1923, are of opinion that, in the best interests of real humanity, animal experimentation, including vivisection, as practiced in our laboratories to-day, should continue unhampered.

ACTIVITIES OF THE ROCKEFELLER FOUNDATION

A REVIEW of the work of the Rockefeller Foundation in 1922, written by its president, Dr. George E. Vincent, will be issued shortly. As the close of the year brought the Foundation almost to the completion of its first decennium, a résumé of the activities of the organization since its establishment in 1913 has been included in the annual report. The work done by the foundation in 1922 directly and through its departmental agencies—the International Health Board, the China Medical Board and the Division of Medical Education—is summarized as follows:

Endowed chairs of medicine and of surgery in Hongkong University;

Pledged $1,125,000 toward new buildings for the College of Medicine of the State University of Iowa;

Contributed to the current maintenance of two medical schools in Canada;

Completed the buildings, strengthened the faculty and wholly financed the Peking Union Medical College;

Agreed to appropriate $300,000 toward laboratories and premedical teaching in two Chinese institutions and in one missionary university in Peking;

Helped 19 hospitals in China to increase their efficiency in the care of patients and in the further training of doctors and nurses;

Promised to cooperate in the rebuilding and reorganization of the medical school of São Paulo, Brazil, and of the medical school of Siam in Bangkok;

Made a survey of medical schools in Austria, Czechoslovakia, Germany, Hungary, Poland and Switzerland, and studies of English and Scotch methods of clinical teaching;

Sent eminent medical men as visiting professors or consulting officers to China, the Philippines, Brazil and Salvador;

Arranged for a commission of medical scientists from Strasbourg to visit the United States and England;

Gave emergency aid in the form of medical literature, laboratory supplies and apparatus, fellowships and stipends to promising investigators and teachers in the Pasteur Institute of Paris and in many other European centers;

Pledged two million dollars toward the site, building and equipment of a school of hygiene in London;

Cooperated with state boards of health in maintaining institutes and instruction for health workers;

Shared in malaria control in 34 county-wide and 32 town demonstrations in ten southern states and continued field studies and surveys in the United States, Porto Rico, Nicaragua, Brazil, Palestine, Australia and the Philippines;

Cooperated with the Mexican and other governments in restricting the prevalence of yellow fever;

Resurveyed centers of hookworm infection in four southern states, and carried on control work in 21 foreign governmental areas;

Took part in promoting full-time health service in 163 counties in 18 states of the United States, and in several counties in Brazil;

Agreed to support for five years the disease-reporting service and for three years the international exchange of health personnel program of the Health Section of the League of Nations;

Provided fellowships in public health, medicine, nursing, chemistry and physics to 237 advanced students from 23 countries;

By consultation and providing of personnel aided public health administration in the United States, Australia, Brazil, Canada, Central America, Czechoslovakia, France and the Philippines;

Contributed to mental hygiene projects, demonstrations in dispensary administration, hospital information service, surveys of nursing education and hospital management, the organization of tuberculosis work in France, the training of French health visitors and other undertakings in the fields of public health and medical education.

SCIENTIFIC NOTES AND NEWS

PROFESSOR CHARLES S. SARGENT, of Harvard University, director of the Arnold Arboretum, has been awarded the Frank N. Meyer Agricultural Medal by the American Genetic Association "for distinguished services in the field of foreign plant introduction." The medal, which had been sent to Harvard to be bestowed upon Dr. Sargent, was presented by President Lowell at a luncheon given by Dr. Sargent for the overseers' committee on the Arnold Arboretum.

A CITATION for the award of a distinguished service medal to Dr. Harvey Cushing, Moseley professor of surgery at the Harvard Medical School, has been approved by Secretary of War Weeks. The citation refers to Dr. Cushing as senior consultant of surgery of the American Expeditionary Forces and in direct charge of treatment of gunshot wounds of the first army hospital during the Meuse-Argonne offensive and says: "He performed conspicuous and distinguished services to the government" and "his individual efforts in that capacity saved the lives of many severely wounded soldiers."

JOHN V. N. DORR, metallurgist of New York City, was elected on May 7 to honorary membership in the Society of Phi Lambda Upsilon, through the Columbia Chapter, at a dinner given in his honor by the National Organization at the Chemists' Club, New York City.

WE learn from *Nature* that the Royal Society of Edinburgh has awarded the Makdougall-Brisbane prize (1920-1922) to Professor W. T. Gordon for his paper on "Cambrian organic remains from a dredging in the Weddell Sea," published in the *Transactions* of the Society within the period, and for his investigations on the fossil flora of the Pettycur Limestone, previously published in the *Transactions*.

THE members of Sigma Gamma Epsilon, at the University of Michigan, recently gave a luncheon in honor of Professor Carl O. Sauer, who leaves the university at the end of the summer session to become head of the department of geography of the University of California.

AT the anniversary meeting of the Linnean Society on May 24, the High Commissioner for New Zealand received the Linnean gold medal on behalf of Mr. T. F. Cheeseman, of the Auckland Museum, New Zealand. Dr. John Isaac Briquet, director of the Geneva Botanical Garden, has been elected a foreign member of the society.

DEAN E. A. HOLBROOK, of the Pennsylvania State College School of Mines, has been retained by the United States Coal Commission to prepare a report on mine safety work in this country.

PROFESSOR HERMAN H. CHAPMAN, of Yale University, has been appointed a member of the Connecticut State Park and Forest Commission.

AT the inauguration of President Samuel Wesley Stratton, of the Massachusetts Institute of Technology, to occur on June 11, the American Association for the Advancement of Science will be officially represented by Mr. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, and by Professor Samuel C. Prescott, professor of biology and public health in the Massachusetts Institute of Technology.

THE appointment of Dr. Frederick E. Breithut as chemical trade commissioner of the United States to Germany and other European countries has been announced by the Department of Commerce. Dr. Breithut will be attached to the staff of the commercial attaché; Charles H. Herring, Berlin, but will study the chemical industries in England, France and elsewhere in Europe where there have been developments of interest to the United States.

DR. P. A. MAPLESTONE, lecturer on protozoology at the Liverpool School of Tropical Medicine, has been appointed assistant director of the research laboratory at Sierra Leone.

A. W. AMBROSE, assistant director of the Bureau of Mines, has resigned to become associated in an executive capacity with the Empire Companies, with headquarters at Bartlesville, Oklahoma.

DR. RICHARD B. MOORE, chief chemist of the Bureau of Mines, has resigned his post to take effect on June 1. Dr. Moore will be succeeded by Dr. Samuel C. Lind, who has for some years acted as a superintendent of the Rare and Precious Metals Experiment Station of the bureau at Reno, Nevada. Dr. Moore will enter the commercial field with a firm of consulting chemists and metallurgists in New York city.

PROFESSOR W. K. KIRBY, head of the petroleum engineering department of the Colorado State School of Mines, leaves early this month for New York, where he has accepted a position with the J. G. White Engineering Corporation.

C. G. STUPP, formerly assistant chief chemist of the research department laboratory of The Barrett Company, New York City, and more recently with the National Aniline and Chemical Company, Buffalo, New York, has resigned to accept a position with Weiss and Downs, chemists and chemical engineers, New York City.

DR. J. J. SKINNER, of the Bureau of Plant Industry, has returned to Washington, having completed the supervision of fertilizer applications in the cooperative experiments and inaugurated fertilizer experiments with cotton in Fayetteville and New Bern, North Carolina.

LANGDON WARNER, recently director of the Pennsylvania Museum in Philadelphia, who was a member of the Pumpelly-Carnegie expedition to Trans-Caucasia in 1904-05, assistant curator of oriental art in the Boston Museum of Fine Arts from 1906 to 1913, and subsequently field director of the Cleveland Museum of Art, has been appointed fellow of the Fogg Art Museum of Harvard University for research in Asia.

DR. EDWIN E. SLOSSON, director of Science Service, sailed on May 29 for Europe to attend the commemoration of the three hundredth anniversary of the founding of the city of Gothenburg, Sweden, and an exposition of Swedish industries and culture. Dr. Slosson plans also to investigate some of the chemical industries of Sweden. He will return early in July.

GEORGE S. RICE, in his official capacity as chief mining engineer of the United States Bureau of Mines, is attending the International Mining Exhibition in London June 1 to 15. He will spend several months in the British Isles and on the Continent in the study of coal mining. While in Great Britain, he will give an illustrated lecture at the University of Sheffield.

LEAVE of absence has been granted to Mr. N. A. Wood, of the Museum of Zoology of the University of Michigan, to take part in an expedition being financed by Ginling College, Nanking, China, which will penetrate into certain little-known parts of China.

F. L. STEVENS, professor of plant pathology in the University of Illinois, will spend the summer collecting fungi in Central America, chiefly in Costa Rica.

KIRTLEY F. MATHER sailed from Seattle on June 7 for Alaska, where he will be engaged in field examinations in the Iliamna-Katmai region under the auspices of the United States Geological Survey. After his return, about October 1, he will serve until February 1 as visiting lecturer in geology at Harvard University.

DR. GEORGE E. BEYER, entomologist of the state board of health, New Orleans, formerly adjunct professor in biology at Tulane University School of Medicine, has been requested to aid in stamping out malaria in San Domingo. Dr. Oscar Dowling, president of the state board of health, has granted Dr. Beyer a leave of absence.

DR. LOUIS L. WILLIAMS, JR., Richmond, Virginia, engaged in malaria control work with the state department of health, has been appointed to represent the United States on the epidemic committee of the League of Nations. Dr. Williams sailed on May 1 for Italy, where he will spend four months studying malarial problems.

AMONG the foreign physicians who are expected to take part in the meeting of the American Medical Association at San Francisco during the week of June 25 are Dr. F. G. Banting, discoverer of insulin; Professor Wenckebach of Vienna, noted for his work on the use of quinin derivatives in the treatment of heart disease; T. C. Routley, secretary of the Canadian Medical Association, and Dr. S. A. K. Wilson, of London, who will speak on the relation of accidents to nervous diseases.

PROFESSOR BERNHARD H. DAWSON, chief astronomer in the observatory of La Plata, left Argentina in the latter part of May for six months' leave of absence which will be spent chiefly in the United States.

DR. WM. H. NICHOLS, on the occasion of the twenty-fifth anniversary of the founding of the Chemists' Club, New York, on May 2, presented the club with five hundred shares of the stock of the Chemists' Club Building Corporation, valued at $25,000. The following officers were elected: *President,* F. J. Metzger; *resident vice-president,* Allen Rogers; *non-resident vice-president,* E. R. Weidlein; *treasurer,* A. G. Robinson; *secretary,* Herbert G. Sidebottom; *trustees,* A. A. Holmes and Thomas R. Duggan.

PRESIDENT EDWARD A. BIRGE, of the University of Wisconsin, was the principal speaker and guest of honor at the annual banquet and meeting of the Phi Beta Kappa fraternity, June 6, at the University of Chicago.

DR. EDGAR T. WHERRY, of the United States Bureau of Chemistry, lectured before the Kentucky Chapter of the Society of the Sigma Xi on May 18, his subject being "Studies of soil acidity and plant distribution."

PROFESSOR MORTIMER E. COOLEY, dean of the engineering school of the University of Michigan, will deliver the commencement address at the Armour Institute of Technology. His subject will be "The responsibility of education."

DR. E. E. SLOSSON, of Science Service, Washington, D. C., gave an address on "The human side of science," before the fourth annual meeting of the New Hampshire Academy of Science, on May 26.

DR. HENRY H. DALE, London, delivered the Oliver-Sharpey lectures at the Royal College of Physicians of London on May 1 and 3 on the "Activity of the capillary blood vessels and its relation to certain forms of toxemia."

THE twelfth biennial Huxley lecture, on recent advances in science and their bearing on medicine and surgery, will be given at the Charing Cross Hospital Medical School by Professor Sir Arthur Keith, F.R.S., on June 27.

C. G. DARWIN, grandson of Charles Darwin, recently addressed the Southern California Section of the American Chemical Society, at Los Angeles, on "The periodic system." Mr. Darwin has been appointed to the new Tait chair of natural philosophy at Edinburgh University.

A COMMITTEE has been formed in England to commemorate the services of the late Dr. W. H. R. Rivers to anthropology and psychology, which includes Sir Charles Sherrington, president of the Royal Society, Sir Humphry Rolleston, president of the Royal College of Physicians, Sir James Fraser, Dr. Henry Head, Professor Elliot Smith and Dr. C. S. Myers. The treasurer is Dr. L. E. Shore, St. John's College, Cambridge, to whom contributions may be sent. It is intended that the proceeds of the fund shall be devoted to the promotion of those sciences in which Dr. Rivers took a special interest, but until the amount and the wishes of the contributors are known no definite decision will be reached.

THE celebrations in France of the Centenary of Pasteur began in Paris on May 17 when the foreign delegates were received by M. Millerand, the president of the Republic, at the Elysée. On the following morning the Pasteur Institute and the tomb of the great scientist were visited and in the afternoon a solemn ceremony, over which M. Millerand presided, took place at the Sorbonne. On May 26, there was a visit to the École Normale in the morning and a reception at the Hôtel de Ville in the afternoon. On May 27 the delegates were received by various learned societies and in the evening there were gala performances at the Opéra and the Théâtre Français. A banquet was held at Versailles on May 28, when the palace was visited and the Grandes Eaux played. On the afternoon of May 29, a garden party, organized by the Institut de France, was given at Chantilly. On the following day the delegates traveled to Strasbourg, where, on May 31, the monument to Pasteur was unveiled and after luncheon the Palais du Rhin was visited. Later in the afternoon the Pasteur Museum and the Hygiene Exhibition was opened and in the evening there was a reception at the Strasbourg town hall.

In connection with the celebrations a Pasteur postage stamp has been issued.

PROFESSOR J. COX, lately professor of physics in McGill University, died on May 13, aged seventy-two years.

PROFESSOR C. NIVEN, F. R. S., lately professor of natural philosophy in the University of Aberdeen, died on May 11, at seventy-eight years of age.

COLONEL G. F. PEARSON, formerly inspector-general of forests in India, died on April 25, aged ninety-six.

WE regret to record also the deaths of Sir Shirley Murphy, known for his work on epidemiology, and of General E. A. Lenfant, the French explorer.

THE Fourth International Neurological Congress will be held at La Salpêtrière in Paris on June 8 and 9, when the subject for discussion will be compression of the spinal cord.

YALE UNIVERSITY OBSERVATORY has awarded a contract to J. B. McDowell and Company, Pittsburgh, for the optical parts of a 26-inch photographic telescope of thirty-six feet focal length. It is expected that this telescope will be in use within a year. It is to be erected at some site south of the equator, probably in South Africa or in New Zealand.

A DELEGATION of American scientific men will attend the Second Pan-Pacific Scientific Congress to be held at Sydney and Melbourne, Australia, from August 13 to September 3. The international meetings will be under the direction of the Australian National Research Council and will include addresses in all fields of science. The American delegates announced by the National Research Council are: C. M. Cook, Jr., zoologist, Honolulu; H. E. Crampton, professor of zoology, Barnard College, New York City; E. M. Ehrhorn, entomologist, Board of Commissioners of Agriculture and Forestry, Honolulu; H. E. Gregory, director, Bishop Museum, Honolulu; William H. Hobbs, geologist, University of Michigan; Ellsworth Huntington, research associate in geography, Yale University; T. A. Jaggar, Jr., volcanologist, Honolulu; Elwood Mead, professor of rural institutions, University of California; W. E. Ritter, director, Scripps Institution for Biological Research; R. R. Sayers, chief surgeon, United States Bureau of Mines; Charles F. Shaw, professor of soil technology, University of California; E. C. Stakman, professor plant pathology, University of Minnesota; L. R. Sullivan, anthropologist, American Museum of Natural History; Otto H. Swezey, entomologist, Honolulu; T. Wayland Vaughan, United States Geological Survey; Nevin M. Fenneman, chairman, division of geology and geography, National Research Council.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $500,000 has been made to Harvard University by Edward Mallinckrodt, chemical manufacturer of St. Louis, toward the erection of a chemical laboratory.

UNDER the will of Walter H. Kimball, of Providence, Brown University receives the major portion of his estate, which is estimated at $300,000.

IN memory of the late Lady Herdman, Sir William Herdman, of Liverpool, who was president of the British Association in 1920, has presented to Liverpool University £20,000 for the provision of a building for the department of geology. The new building is to bear Lady Herdman's name. During the war Sir William and his wife gave £10,000 to the university, in memory of their only son, who was killed in the war.

DR. WILLIAM D. CUTTER has resigned as secretary of the Board of Medical Examiners of New York state to become dean of the New York Post-Graduate Medical School and Hospital.

PROFESSOR EDWARD H. KRAUS, of the University of Michigan, dean of the summer session and former acting dean of the college of pharmacy, has been appointed dean of the college.

DR. THOMAS BURR OSBORNE, of the Connecticut Agricultural Experiment Station, has been appointed research associate in biochemistry in Yale University with professorial rank.

PROFESSOR LEON E. JENKS, formerly of the Universities of Pittsburgh and Buffalo, has been chosen to develop the courses in economic chemistry recently started at the College of the City of New York. He fills the vacancy caused by the appointment by Secretary Hoover of

Professor Frederick E. Breithut as chemical trade commissioner to Germany.

DR. CHARLES HASKELL DANFORTH has been appointed associate professor of anatomy in the Medical School of Stanford University.

MR. L. J. MORDELL, B.A., Cambridge, has been appointed a Fielden professor of pure mathematics at the University of Manchester as from September next.

DISCUSSION AND CORRESPONDENCE

MATHEMATICAL PROPAGANDA

AN unusually significant type of mathematical propaganda is noted in a recent number of the *Jahresbericht der Deutschen Mathematiker-Vereinigung.* It is here stated that as a result of the unfriendly tendencies towards mathematics there has been organized a kind of super-union of the various mathematical organizations in Germany. Twenty-one of these organizations have already associated themselves with this union, which explicitly aims to spread the practical and cultural significance of mathematics and to represent it in the public life of the German people. It aims further to establish a close union between investigation, teaching and practice with a view to their mutual advancement and inspiration.

The union is called *Mathematische Reichsverband* and it aims to hold at least one meeting each year composed of the delegates of the various organizations which belong to the union. Questions involving the work of the individual organizations associated with the union are not to be discussed at these general meetings and, in particular, such questions shall not be decided by a majority vote. On the contrary, the independence of these individual organizations is to be maintained in every respect. It claims to be already a union of *all* German mathematicians independently of whether their interests relate mainly to research or to teaching.

The tendency to bring investigators, teachers and agitators into the same fold found expression in our own country several years ago in the organization of the Mathematical Association of America, but the German movement noted above seems to be a much more pronounced effort towards uniting all the mathematicians of a country for the purpose of combating the unfriendly forces which have already made serious inroads into their favorite domain. These united efforts should result in a deeper study of the place which mathematics is destined to occupy in the civilized world and, in particular, in the educational systems designed to meet the needs of various classes of people.

It remains to be seen whether the mathematical material can be so reorganized that it will appeal strongly to the youths of our generation. The report on the reorganization of mathematics in secondary education, recently issued under the auspices of the Mathematical Association of America, is a serious effort in this direction and is in line with the aims of the union of German mathematicians noted above. Scientists will naturally watch with interest such developments in view of the fact that scientific expositions are frequently affected by the amount of mathematical knowledge that may be assumed on the part of the reader.

G. A. MILLER

PEARL'S BIOLOGY OF DEATH

PEARL'S "Biology of Death," published by Lippincott in the series of Monographs on Experimental Biology, though almost unique in English in content, is remarkably free from the controversial. As a work which has already opened up new fields of research it is desirable that its line of argument should be free from ambiguity and question.

The concluding chapter includes a series of curves purporting to emphasize two things, *viz.*

1. That the trend of human mortality in time is an extraordinarily complex biological phenomenon, in which many factors besides the best efforts of health officials are involved.
2. That for many causes of death a vast lot needs to be added to our knowledge of etiology, in the broadest sense, before really efficient control can be hoped for.

No exception can be taken to the correctness of these two statements, but there does seem considerable doubt that the graphs selected to illustrate them are adequate. This can be shown by reference to Fig. 55, p. 236. Here we have two logarithmic curves representing the weighted average death rate from typhoid fever respectively for countries having highly developed public health and sanitation (A) and for countries having less highly developed public health and sanitation (B). The A-group consists of Australia, Austria, England and Wales and Germany. The B-group consists of Italy, Jamaica and Roumania. The duration of the time represented runs from 1898 to 1912. Fig. 55 shows a decline in the death rate in both A and B groups at approximately the *same* rate. Pearl remarks, "There is no such large difference as would be expected if organized human interference with the natural history of disease always played" a rôle of immediate and large importance.

Before concluding that these curves indicate a lack of efficacy in public health measures, it would be necessary to continue these curves back to a time before the A-group differentiated itself from the B-group in the matter of possessing a more highly organized system of sanitation. If the two curves could be shown to have diverged since the organization of the A-group sanitation system, their present divergence might represent the effects of sanitation. It is likely that these effects would relatively soon make themselves apparent. In the years immediately succeeding their institution a very marked decline in the death rate in the A-countries might have occurred, attributable to the elimination of preventable deaths. But after this new level or equilibrium had been reached, the new A-curve might run fairly parallel with continuation of the B-curve. The absence of the preventable factor might not materially alter the general form of the A-curve because of its relative insignificance (Pearl, p. 165).

In other words the curves in Fig. 55, instead of being interpreted as minimizing the effects of public sanitation, may be interpreted (I do not assert that I do) as representing the results of two different groups of components; in the case of B the sum of all the factors contributing to typhoid mortality, in the case of A the same sum *minus* the "controllable" factor.

In order to show the limitations of public sanitation in lowering the death rate it would be preferable to reduce the variability in certain factors, *e.g.*, racial susceptibility, climate and diet to a minimum. This can not be secured in the selection of the widely diversified countries, made by Pearl. The effects of public sanitation might be more clearly apparent in following the death rate in the disease in question prior to, during and after the institution of such sanitary measures within the same national and geographic group; *e.g.* the mortality of diphtheria in Germany before and after the institution of antitoxic treatment. Pearl himself follows an analogous method in the case of malaria (Fig. 57) and of yellow fever (Fig. 58).

The objection made above that Fig. 55 need not show what Pearl used it to show can possibly be made clearer by reference to Fig. 56. Here we have logarithmic curves representing the course of the death rate in diphtheria, between 1898 and 1912, in the same A and B groups of countries. The fact that the A-curve is higher than the B-curve probably illustrates the predominant influence of such intangible uncontrollables as racial constitution (heredity), climate and diet. Although the curves in Fig. 55 (typhoid) do not in themselves afford anything contradictory to the interpretation put upon them in the text, the curves in Fig. 56 (diphtheria) seem to offer intrinsic difficulties. There has been no significant decrease in the B-group since about 1903, while in the A-group (*i.e.* where sanitation was well organized) the decrease was continuous except for an interruption to which reference will be made.

Beginning about 1906 in the B-group there is a conspicuous deflection of the curve from the base line representing a significant rise in the death rate which continued till about 1911. It is of interest to note that a similar deflection, *but relatively far less significant,* occurred in the A-curve, beginning about 1907, *i.e.* a year *later* than was the case in the B-curve. A recognition and evaluation of the factors actually responsible for these deflections would be interesting. A purely hypothetical explanation, though a possible one, would be that beginning in 1906 a factor or a group of factors became quite universally operative tending to raise the death-rate in diphtheria. The more highly organized sanitary system of the A-group of countries postponed the effects of these factors for a year and during the few years of their operation succeeded in to some degree counteracting them.

This note does not question the validity of Pearl's theses as presented in the second paragraph but it does suggest that the evidence, particularly Figs. 55 and 56, is inconclusive and ambiguous. These curves do show that there is general downward trend in the death rate regardless of the state of public sanitation, but it is questionable if they do show the relative unimportance of sanitary measures in lowering the death-rate in these particular cases.

JOSEPH L. APPLETON, JR.

TWO MEDITERRANEAN CLOVERS NEW TO THE UNITED STATES

AMONG the specimens received for identification at the Bureau of Plant Industry during the past year are two Mediterranean species of clover, neither of which seems to have been recorded previously from the United States. In view of the possibility of their establishment as weeds in this country, it seems well to place on record the place and date of their first appearance here.

The first species, *Trifolium hirtum* All., is a native of the Mediterranean region and northern Africa. A series of specimens of this species, collected at Farmville, Virginia, on May 15, 1922, has been forwarded by Mr. P. W. Fattig. Mr. Fattig writes that he first found it growing in an old lot which had been cultivated a few years ago, and that a negro who is now cultivating the lot informed him that the clover had been there for about ten years. A few plants were also found by Mr. Fattig growing along fences or in paths at distances of twenty rods, eighty or a hundred rods, and half a mile from the spot where he first noticed it.

The second species, *Trifolium angustifolium* L., occurs also in the Mediterranean region of Europe, Asia Minor and Africa, as well as in the Azores and the Canary Islands. Specimens of this species, collected in a field of California bur clover in Montgomery County, Alabama, in June or July, 1922, were sent for identification by Professor Wright A. Gardner, of the Alabama Polytechnic Institute. Professor Gardner has since written that the seed from which the crop was grown was obtained from the Sherman Grain and Seed Co., Sherman, Texas, and that he has been told that the same clover has appeared in other plantings of seed from the same source, although he has no definite information as to how widely the plant is distributed in Alabama.

Trifolium hirtum is an annual, suggesting the ordinary red clover, *T. pratense*, in its general appearance and pubescence, but smaller. The leaflets are obovate, 1 to 2 cm. long and 6 to 15 mm. wide, broadly rounded, subtruncate, or obscurely notched at apex, finely denticulate, and rather densely pilose on both sides. The sessile, involucrate heads are subglobose or oval, about 1 to 2 cm. long and 1.5 to 1.8 cm. thick (excluding the corollas). The purple-red corollas have a narrow elongate banner. The sessile, turbinate, densely silky-pilose calyx tube is 20-nerved and about 3 mm. long, and the setaceous-subulate teeth are plumose and about 5 mm. long. In fresh specimens the hairs of the calyx are whitish, but in old herbarium specimens they change to brown.

Trifolium angustifolium is also a pubescent annual, reaching a height of one or two feet. Its leaflets are linear or very narrowly linear-lanceolate, 2 to 5.5 cm. long and 2 to 4 mm. wide. The pedunculate, exinvolucrate heads are at first ovoid or oval, becoming at maturity cylindric and reaching a length of 2.5 to 8 cm., with a diameter (exclusive of corollas) of 1.8 to 2 cm. The corollas are "rosy." The sessile, obconic, 10-nerved calyx is about 4 mm. long, and is rather densely hirsute-pilose, while the plumose, setaceous or setaceous-subulate teeth are 4 to 7 mm. long. As in *T. hirtum*, the pubescence of the calyx is white at first, changing to brown or bronze in old herbarium material.

Specimens of both species have been deposited in the United States National Herbarium, the Gray Herbarium, the herbarium of the New York Botanical Garden and the herbarium of Professor L. H. Bailey.

S. F. BLAKE

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

"THE FRIENDLY ARCTIC"

IN the issue of SCIENCE of March 30, 1923, there appeared two letters—one by Mr. V. Stefansson and the other by Messrs. McConnell and Noice, in which the statement is made that the minister of mines declined to investigate charges made by certain members of the Canadian Arctic Expedition against Mr. Stefansson and the impression one gets from this is that the minister's refusal to make an investigation was due to his support of Mr. Stefansson's side of the controversy.

To avoid any misconception of the minister's motives in this matter, I wish to give you the following facts:

An inquiry was asked for not by one of the parties to the controversy alone, but by Mr. Stefansson as well.

The minister declined to grant the request of either party for the reason that no good could come of such an inquiry and much harm might be done. Too much publicity, unfortunately, had already been given to the differences that had arisen between members of the expedition and any more was highly undesirable. To avoid further publicity was the minister's only motive in refusing to grant an inquiry.

The main point on which an inquiry was asked for by the party represented by Mr. Jenness was the so-called mutiny at Collinson Point, referred to in "The Friendly Arctic." To designate this incident as a mutiny is using too strong a term, for it was a decision on the part of the so-called mutineers to adhere to instructions originally given them by the Geological Survey in the pay of which organization these men were throughout the whole expedition. One has only to reflect on what a mutiny means and he will realize that if there were sufficient grounds for such a charge steps would have been taken long before this by the government to punish the offenders.

I make this explanation in justice to Mr. Jenness and the men associated with him and trust that no more may be heard of a controversy that has already gone too far and a continuation of which can do no one any good.

CHARLES CAMSELL
Deputy Minister

To the Editor of SCIENCE: It has been pointed out to me that in my comment on the article on "The Friendly Arctic," published over the signature of Diamond Jenness in SCIENCE for July 7, 1922 (see SCIENCE, March 23, 1923), I have made a statement which, although clear in itself, is ambiguous because of its context. I said: "The Minister of Mines (the head of the department in which Mr. Jenness is employed) declined to investigate written charges submitted by Mr. Jenness and four or five of the men who had been in the section of the expedition that disobeyed instructions."

I meant to say exactly what the words here say when divorced from their context. But a sentence earlier in the same paragraph leaves the statement open to being interpreted as one describing an action where the Minister of Mines decided in my favor as against Mr. Jenness and his colleagues. This was not the case and I did not mean to imply any such thing. The position of the Minister, as explained in a brief letter to me and more fully in conversation by himself and by the Deputy Minister of Mines, Mr. Charles Camsell, was that it appeared to him that no investigation was called for by the charges as presented or by the facts in so far as he had investigated them.

In this connection his position is made all the clearer by remembering that I had already asked for an investigation before the charges against me were submitted to the Minister of Mines (the Honorable Charles Stewart) and that I telegraphed to the government immediately on seeing the newspaper account of the charges submitted to Mr. Stewart, urging that the investigation asked for by Mr. Jenness and his colleagues should be promptly and thoroughly carried out. The minister, accordingly, declined not only to make the investigation asked for by my opponents but declined also to make the same investigation when requested by myself. Thus his attitude remains merely one of aloofness from the situation created.

VILHJALMUR STEFANSSON

SCIENTIFIC BOOKS

A Study of American Intelligence. By CARL C. BRIGHAM. Princeton. Princeton University Press, 1923, pp. xxv, 210.

THE purpose of this volume is "to discuss the relations of the army measurements of intelligence to nativity and residence," to analyze, further, the intelligence of the race and nationality groupings uncovered in our recent draft army. The data are taken from the "Psychological Examining in the United States Army" (Memoirs of the National Academy, XV).

The book is divided into two distinct treatments. Part I, occupying one third of the whole, is a review of the already familiar material on the make-up and statistical reliability of the army mental tests. Part II contains the statistical analyses of the army test results as they bear on race and nationality. Figures showing the overlapping of officer scores on those of the native white draft and the foreign born draft are presented. Following these are elaborate tables of the average scores, with P. E.s, of draftees from various nativity groupings. The main theses of the work are here put forth: (1) to discover the differences on the average, with the P. E.s of the differences, in the intelligence scores of the men in the army from various European countries; (2) to examine the correlation of length of residence with average scores in the tests for these same groups.

The findings under the first topic show a decided difference in the test-results for the North European immigrants as compared with those from Southern and Eastern Europe. Professor Brigham, moreover, presents negative data on the alleged language handicap in the testing of the latter groups.

On the second head, the analysis of the materials in terms of years of residence in the United States shows a "steady increase in the average scores with increasing years of residence" (p. 89). Those foreign born who have been in this country over twenty years actually exceed, slightly, the average for the native born white draft.

In interpreting his data further, the writer classifies his groups under the familiar headings of Nordic, Alpine and Mediterranean races. He shows that there has been a marked change in the "racial" extraction of our immigrants in the past two or three decades. The swing has been clearly from Northern to Southern and Eastern Europe. By resorting to the Gobineau race hypothesis held by Madison Grant, Lothrop Stoddard, Charles W. Gould and others the conclusion is arrived at that this shift in the source of European immigration has brought inferior races into this country. The data presented from the army intelligence tests are held to support this as witnessed in the large differences between the scores of nationalities from the former section as compared with those from the latter.

Before concluding his work, the ubiquitous problem of negro mentality is introduced and comparisons made with the European nationalities and the white native born draft and officers. The negro actually ranks below the poorest of the European nationalities: Russia and Poland. (Thus is the white race saved from complete disgrace!)

The conclusions, therefore, to which Professor Brigham would bring his readers may be stated briefly as follows:

(1) The army mental tests are adequate measurements of innate intelligence. The alleged handicaps of the tests for the foreign born draftees do not exist due to the large use made of beta and the performance tests.

(2) The average scores for the native born draftees exceed those of the foreign born.

(3) Further analysis of the foreign born, however, reveals important differences between those of Northern and those of Southern and Eastern Europe.

(4) Appeal is made to the race hypothesis of the Gobineau school to show that the Alpine and Mediterranean races are innately inferior in mentality to the Nordic race. The northern immigrants belong predominantly to the latter, the southern and eastern immigrants to the other two.

(5) Moreover, the change in the composition of the European immigrations in the past two decades has brought an increasingly preponderant inferior racial stock into this country.

(6) Finally, it follows from this that the mixture of the newly arrived inferiors with the formerly arrived superiors will end in a decrease in the native intelligence of our American, *i.e.*, by implication, Nordic stock. The existence of a large body of low-grade mentalities among the negroes complicates the problem still more. Hence steps should be taken to insure the selection of future immigrant strains of higher order, again by implication—the Nordic race only.

Space prevents an adequate critique of such far-reaching results and interpretations. The following aspects seem in need of mention, first in regard to Part I and then in reference to Part II:

(1) The statistical samples of the draftees are biased in favor of those groups of persons

who did not receive exemption for professional service, essential industries and for services of the farm-owning classes. This raises a legitimate question as to possible bias in all the results, but particularly in reference to the foreign born, many of whom must have escaped the draft because of skill in trades or need in war industries. This would leave possibly classes of these groups who did more poorly in the tests than a fair sample of their nationality would indicate.

(2) We are far from being certain that the particular make-up of the alpha, beta and Binet tests are properly weighted in regard to the elements which should go into so-called intelligence. At best we must define intelligence here, as elsewhere, as a purely statistical score in a particular test, or as it has been put, "intelligence as the tests test it."

(3) In considering the actual distributions of the individual tests in the various batteries, the large percentage of zero scores is noteworthy. In all alpha tests but one and two the number of zero scores constitutes the largest quantity for any given measure on the scale. Furthermore all the alpha tests are skewed, principally toward the lower end of the scale. None of the test distributions are "normal" in strict terms of the Gaussian curve; only the results of tests one, three and eight are even roughly so.

The beta results, in contrast to alpha, show a rather uniform skewing toward the upper end of the scale. Also the beta distributions are more variable in form than those in alpha. Tests one, two and six are roughly "normal," but still skewed to the right, tests three and five appear bi- or even tri-modal, while test seven is definitely tri-modal. The extreme complexity of multi-modal curves is well known in statistics, but these difficulties were avoided by the army psychologists in lumping together, by statistical formulae, all data under the Gaussian curve.

Professor Brigham's discussion of the Stanford-Binet tests, used for individual examination, is more critical. Even here his statement that "a rough inspection of these figures (on the Binet results of 1,047 experimental cases) shows that they give us the Gaussian normal distribution" (p. 54) will not bear careful scrutiny as any one may discover who will take the trouble to construct a line graph of the findings as he reports them. We must, then, take exception to his statement that "the results obtained from the Stanford-Binet examination may be taken as entirely reliable without question" (p. 54). In view of the accumulating criticism of the entire testing movement one can not help feeling that this assertion is, to say the least, overdrawn. It is only fair to the writer, on the other hand, to note that his use of the term "mental age" "as a *score* not as a diagnosis" accords with sane practice. He properly criticizes those sociologists, publicists and others who have gone about the country in misconception glibly saying that the average American has the mental ability of a thirteen year old child. In general, however, the writer ignores such essential psychological problems in mental measurement as have recently been raised again by Boring and Yule, accepting, on the whole, the purely statistical approach to his problem.

It is Part II which presents even greater difficulty in criticism. The naïve assumption of an anthropology which scientific workers abandoned two or three decades ago, the confusion of issues by reasoning from intelligence scores of immigrant stocks in this country to the intelligence of the entire racial stock from which they sprang and the implicit one-hundred-per cent. Americanism[1] in the entire discussion of the results makes one pause to wonder whether the book is to be considered science or special pleading. Looking closely at the difficulties in the treatment we note the following:

(1) The novel manner in which Professor

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[1] For instance, note the following easy manner in defending the clearly admitted speed element in the tests: "It is sometimes stated that the examining methods stressed too much the hurry-up attitude frequently called typically American . . . If the tests used included some mysterious type of situation that was 'typically American,' we are indeed fortunate, for this is America, and the purpose of our inquiry is that of obtaining a measure of the character of our immigration. Inability to respond to a 'typically American' situation is obviously an undesirable trait." (p. 96). What kind of trait? Mental or emotional? How long does it take to acquire the "typically American" trait? etc.

Brigham has dealt with the question of length of residence of the immigrant groups in this country. He writes: "The results of the psychological tests of foreign born individuals classified according to length of residence . . . . indicate definitely that the average intelligence of succeeding waves of immigration has become progressively lower" (p. 155). He examined the average scores of the various foreign born draftees whose length of residence was classified into five year periods. As noted above there was a steady decrease in the average score with decrease in length of residence. This is not surprising, but the interpretation is quite so. Because the tests show this difference are we to assume that the intelligence of our immigrants, especially those from Southern and Eastern Europe, was actually lower in 1917 than in those who came over in 1897? Sociologists and economists who have investigated immigration have never given us any evidence whatsoever that the sources of immigration, either in terms of geography, economic status or intellectual classes, have altered in the past twenty years to the extent Mr. Brigham's interpretation assumes. For instance, the Italian immigration of the past twenty years has pretty uniformly come from Southern Italy and Sicily, but there is no real evidence that the persons coming from those sections are growing steadily worse from the standpoint of intellectual capacity. We need comparative studies over a much more extended period than the present writer has allowed. It seems to the reviewer that first of all the obvious explanation should suggest itself: the men who were in the draft army whose residence in this country was five years or less came over practically as adults, as we go back further and further in length of residence it means that the persons tested were increasingly younger in age upon arrival in this country, hence they have been longer exposed to American language, customs and culture. It is true, of course, that Professor Brigham has factored out some of the cultural-language difficulties by comparing the scores of non-English speaking Nordics with non-English speaking Latins and Alpines, finding rather marked superiority of the former over the latter. Again this can hardly be interpreted on his hypothesis until we realize the relative speed of assimilation of the non-English speaking Nordics as compared to the Latins and Alpines until, in short, the cultural factors are controlled. The reviewer does agree that the alleged language handicap has been over-emphasized, but he believes we ought not to pass beyond this to the assumption of decreasing mentality in the quinquennial groups of immigrants until more evidence is at hand than the army data give.

(2) His assumption that the samples of immigrants tested represent the mentality of the racial groups from which they sprang is peculiarly pernicious, especially in view of the fact that on page 155 the writer himself so much as agrees that it is dangerous to reason from the intelligence of draftees to that of immigrants and thence from immigrants to races in Europe. He states: "There are so many variable factors determining immigration that the immigrants can not themselves be taken as representative of the country as a whole." Nor, of course, the racial stock as a whole. Yet in spite of his own frank recognition of this difficulty, he proceeds to an extended discussion of races in Europe ending by making an attempt to calculate the racial proportions for each separate country from which foreign born draftees were chosen. For help here he depended on unnamed collaborators.

The entire matter of race criteria is most complicated, as present students of anthropology well know. We are discovering that there are marked elements in all European peoples which go behind the older divisions into Nordic, Alpine and Mediterranean stocks. Furthermore, the criteria for these three stocks are very difficult to define. The most prominent standard for the Nordic is dolichocephalic head-form coupled with blondness. Brigham accredits Sweden as being one hundred per cent. Nordic, yet Retzius some years ago, showed that in Sweden, although accorded by students of anthropology as most predominantly Nordic, eighty-seven per cent. of the population was long-headed and thirteen per cent. decidedly brachycephalic, or Alpine in head form. Similar difficulties are apparent in his rating on Russia and Germany.

The fact is that the whole race hypothesis for European populations has been largely abandoned by careful workers in European anthropology. As Retzius pointed out in his Huxley lecture in 1909, there are no races, properly speaking, in Europe at all, only sub-races. Moreover, these sub-races are inextricably mixed with one another. Some writers merge the Mediterranean and Nordic strains as a common sub-race.

(3) The most serious fault with Professor Brigham's book, therefore, lies in his naïve acceptance of the Gobineau anthropology. Only the anthropological innocence of a young psychologist could have led him to quote Madison Grant and Lapouge as authorities whose theses his results support. It is by a curious logic that Professor Brigham shifts from a position critical of applying his data to race problems because of the inadequacy of his sample to one which swallows the propaganda of the believers in the Nordic Race Myth.

Moreover, the first quotations which are given from Grant and Lapouge deal with generalizations on emotional, not intellectual, characteristics of various European peoples. Yet nowhere does the writer of the present book claim to be studying character traits of his samples. He concludes that: "In a very definite way, the results which we obtain by interpreting the army data by means of the race hypothesis support Mr. Madison Grant's thesis of the superiority of the Nordic type." (p. 182)

Professor Brigham frankly accepts the extreme position of the Nordic worshippers that it was the predominant Nordic elements which gave to Egypt, Mesopotamia, Phoenicia, Crete and Greece their cultural greatness. One wonders if one dare ask if those Hittite groups in Asia who first discovered the important use of iron, a use which lies at the basis of the modern industrial world, also owe its discovery to some chance blond, dolicho cephalic Nordic who strayed, God knows how, into their midst? Yet Professor Brigham in a footnote (p. 184) writes of "The Passing of the Great Race," "The entire book should be read to appreciate the soundness of Mr. Grant's position and the compelling force of his arguments."

In summary we may say that starting off with an extremely valuable body of data on individual differences which might well serve as suggestive points of departure for an extended study of the mental ability of immigrant groups in this country, especially through more adequate control of the language and cultural factors, Professor Brigham has unfortunately confused the issue of individual differences within groups with the average difference between groups typified by their central tendencies. As Boas long ago pointed out, the differences between members of the same race are infinitely greater than the differences between the averages of the various races themselves.

The writer could have made a strong case for the fact that we are getting certain elements of European populations which, as nearly as rough intelligence tests indicate, are not likely to enhance the mental qualities of Americans. But to obscure the issue by dragging in the race hypothesis made notorious by Gobineau and H. S. Chamberlain is to destroy the effectiveness of any arguments for eugenic reform, immigration restriction laws, or other sociological measures which might be made. Considerable differences are evident between immigrants from Northern and Southern Europe. Two hypotheses may help account for this: (1) the language handicap in the tests themselves, (2) the fact that the type of cheap, unskilled labor which has come into this country in the past twenty years from Southern and Eastern Europe is from classes in the native populations who are of intellectual inferiority when compared with the skilled tradesmen and peasant farming classes who have come into the country in the same period from Northern Europe.

To answer fully the question, however, of intellectual status of such groups careful control must be made of the factors of opportunity, education and language difficulties. There is much hope in the methods of testing being refined and improved and additions made to take in measures of character and will traits. We shall never pass to this second, advanced stage of work, however, if we rest our case as psychologists on the shifting sands of an antiquated, outworn and mythological race hypothesis.

KIMBALL YOUNG

CLARK UNIVERSITY

SPECIAL ARTICLES

MEALY BUGS ON THE ROOTS AND NODULES OF LEGUMES GROWING IN THE FIELD

BESIDES furnishing the plant on which they occur with nitrogen from the air, the bacterial nodules of legumes are a potential food supply for the organisms of the soil. When the plant begins to decline, the nodule does also and from this time invading organisms, principally the bacteria of decay and fungi, play an important part in their disintegration. In some instances, however, the nodules are attacked while in full vigor, the destruction depending mainly on the presence of certain insects or organisms which utilize the tubercles of certain leguminous plants as food. McConnell,[1] Leonard and Turner,[2] have conducted experiments on the destruction of nodules by the bean leaf beetle larvæ, *Ceratoma trifurcata*. Forst., and McConnell[3] has described another insect found feeding on the nodules of wild legumes.

For a number of years observations have been made on root nodules of various legumes grown on the United States Department of Agriculture Experimental Farm, Rosslyn, Virginia, and in the vicinity of Washington, D. C., but previous to the season of 1919 the presence of mealy bugs on annual legumes in the field was not noted, although a species was found to some extent in the Agricultural Department greenhouses in Washington, D. C. In the field, the insects were usually found on the underground parts of the plant and not once were they observed on the foliage. As high as fifteen mealy bugs have been seen on one soybean nodule. While the insects were also noticed on the roots of the soybean, *Soja max*, Piper, navy bean, *Phaseolus vulgaris*, L., Japan clover, *Lespedeza striata* (Thunb.) H. and A. and chickpea, *Cicer arietinum*, L., the position in which they were generally found indicated a preference for nodules on all except red clover, *Trifolium pratense* L., where they were found in the greatest number on the tap root. Infestations have also been observed on the soybean at points near Washington, D. C., in Maryland and West Virginia, in sufficient number to indicate that the insects are widely distributed in this section.

The mealy bugs which were found on legumes grown in the field in Virginia have been identified[4] as the same species which has recently been discovered in the Arlington Farm greenhouse on potted plants. The species of mealy bug which was found in Maryland is closely related to the one found in Virginia.

The name of this insect is *Pseudococcus maratimus* (Ehrh.) which on the Pacific coast is much more commonly called *Pseudococcus Bakeri*, Essig. Mealy bugs of this species are widely distributed on the Atlantic and Pacific coasts and infest the roots and tops of a large variety of plants. The list of reported host plants includes few annual and biennial legumes: infestations by *Pseudococcus trifolii* Forbes,[5] on red clover, *Trifolium pratense* have been noted from Delaware, Illinois, Indiana, Iowa, Kentucky, Michigan, New Jersey and New York, and on white clover, *Trifolium repens* from Illinois, infestations by *Pseudococcus Bakeri* on lima bean, *Phaseolus lunatus* and by *Pseudococcus citrophilus*, Claussen MSS., on sweet clover, *Melilotus alba*, have been reported from California.[6]

As these observations were incidental to other work the only control plants were those which missed natural infestation. Judging from superficial appearances, there was no difference between the infested and uninfested plants. This is a point, however, which can only be checked by carefully controlled experiments. Folsom[6] has stated that *Pseudococcus trifolii* will kill clover plants. The possibility of mealy bugs becoming a menace to the nitrogen-fixing functions of some of our common economic legumes leads to the belief that a wider and more thorough investigation of this question should be made.

---

[1] McConnell, W. R., "A unique type of insect injury," *Jour. Econ. Ent.*, 8: 261-267, 1915.

[2] Leonard, Lewis T., and Turner, C. F., "Influence of *Ceratoma trifurcata* on the nitrogen gathering functions of the cowpea," *Jour. Am. Soc. Agron*, Vol. 10, No. 6, 1918.

[3] McConnell, W. R., "Another nodule destroying beetle," *Jour. Econ. Ent.*, 8: 551, 1915.

[4] Identification of insects and information concerning distribution and general habits kindly furnished by Mr. Harold Morrison, of the United States Department of Agriculture, Bureau of Entomology.

[5] Folsom, J. W., "The insect pests of clover and alfalfa," University of Illinois Agricultural Experiment Station *Bulletin*, 134, p. 190, 1909.

[6] Claussen, C. P., California Agricultural Experiment Station *Bulletin*, 258, 1915.

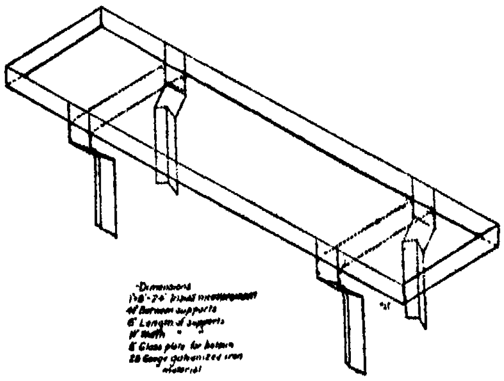
LEWIS T. LEONARD
U. S. DEPARTMENT OF AGRICULTURE

A HISTOLOGICAL SLIDE DRYING PLATE

EXPERIMENTING with a piece of plate glass balanced on top of a steam radiator as a drying plate for histological slides and having this knocked onto the floor and broken is rather disappointing. As a consequence the following piece of apparatus was devised and manufactured.

This slide drying plate is after the fashion of a shallow oblong pan with legs or supports to fit over the coils of a steam radiator. Galvanized sheet iron of number 28 gauge is the material used. The dimensions are as follows: long shallow pan twenty-four by six inches and one inch deep, inside measurement. To the sides of the pan are fastened the supports which fit over the radiator.

These supports are made of the same material as the pan and are one and one fourth inches wide by six inches long. They are fastened to the sides of the pan and to a strip of metal the same width (one and one fourth inches) which goes down the sides and across the bottom of the pan. These are riveted and soldered to the pan. The lower extremities of the supports are bent in the center line to fit more closely to the coils of the radiator for support. The edges of the pan and the legs are turned over five sixteenths of an inch to do away with sharp and rough edges (plate 1).


Dimensions
1×6"-24" inside measurement
4" Between supports
6" Length of supports
1¼" Width " "
5⁄16" Glass plate for bottom
28 Gauge galvanized iron material

The pan is one inch deep in order that a glass plate may be fitted to make a smooth and level surface at the bottom below the rim of the pan. The rim or sides of the pan are to hold the slides in place. Five sixteenths of any inch plate glass is used. This is a means of tempering or evenly distributing the heat to all parts of the plate. It does not require much time to heat and retains the heat. Tests showed that the variations in temperature of the center and the sides were only one or two degrees Centigrade.

This slide drying plate does not get too hot for all ordinary drying purposes. Tests which were made averaged the following degrees of temperature with the room temperature between 21°-24° C. or 70°-75° F.

Centigrade	Fahrenheit
45°-55°	113°-131°

The capacity of this plate is forty-six slides.

The advantage of this as used with a steam radiator is that it can be left there and no regulation of the intensity of heat is necessary. The cost of this device is very little as compared to the various types on the market to-day and any tinsmith can manufacture this piece of apparatus. Many modifications are possible to fit one's needs.

RALPH L. PARKER
IOWA STATE COLLEGE
AMES, IOWA

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY

Frank C. Whitmore, *chairman*
B. B. Renshaw, *secretary*

Special Program on Catalysis

Photochemistry and catalysis: WILDER D. BANCROFT.

Negative catalysis: HUGH S. TAYLOR.

Preparation of platinum black. Effect of the addition of certain salts on the reduction of aldehydes by hydrogen in the presence of platinum black. (Lantern): ROGER ADAMS WITH WALLACE H. CAROTHERS. A systematic study of the effects of varying amounts of ferrous and ferric chloride on the catalytic reduction of benzaldehyde has been made. The catalyst employed was the platinum oxide described in a recent paper by Voorhees and Adams. The optimum effect is observed when the amount of iron chloride corresponds to a concentration of approximately 0.0001 gr. mol. in 100 c.c. of the reaction mixture. Certain abnormalities occur in the experiments where large amounts of ferric chloride are used. This is due to the fact that the ferric chloride is first reduced to ferrous chloride and hydrogen chloride and this latter substance affects the reaction. Ferrous chloride shows no abnormalities in the higher concentrations. The explanation for the difficulty in reducing aldehydes with hydrogen and platinum black is simple. The aldehyde is rapidly oxidized by the oxygen in the platinum black, thus rendering the latter inactive as a catalyst. Acting as an anticatalyst, the ferrous chloride specifically inhibits this oxidation.

The relation of enzyme actions to other catalytic actions: K. George Falk. Specific examples of chemical relations which are catalyzed by enzymes and by hydrogen or hydroxyl ions were given, together with differences and similarities shown by the two sets of actions. Specificities of enzyme actions were compared with specificities of chemical reactions in general. The general chemical nature of enzyme actions was emphasized.

The mechanism of the reactions of esters, acids, alcohols, ethers, amides and alkyl halides at the surface of alumina, titania and thoria: Homer Adkins. The subject indicated in the title has been investigated by studying the effect upon the reactions caused by (1) modifying the spacing of the atoms upon the surface of the catalyst (J. A. C. S., October, 1922, March, 1923), (2) diluting the reacting material with water, alcohol, acetic acid, ethyl acetate, phenyl acetate, phenol, acetone, ethylene or heptane. The mechanism of the reactions is concluded to be as follows: Esters attach themselves directly to the catalyst without any preliminary rupture of the molecule, and then rearrange and react with adjacent molecules, to give varying proportions of acid, ketone, olefin, alcohol, carbon dioxide and water, depending upon the spacing of the atoms of the catalyst. Alcohol and ether are equally stable towards alumina and react by a mechanism similar to that of the esters. Acetic acid attaches itself to the surface of the catalyst and then reacts with a second molecule impinging upon it to give acetone, carbon dioxide and water. Formic acid rearranges, as do the esters, to give either water and carbon monoxide or carbon dioxide and hydrogen.

Oxide equilibria in catalysis: J. M. Weiss, C. R. Downs and R. M. Burns. A study was made of the composition of vanadium oxide which exists during the catalytic oxidation of organic compounds such as benzene, naphthalene, anthracene, etc., in the vapor phase. Of the five possible oxides only two, that is, the tetroxide and pentoxide, are present during the reaction. The proportions of these oxides depend upon the ratio of the hydrocarbon to the oxygen. The results of runs using various ratios of air to benzene from 2 to 1 to 15 to 1 are given in a graph. Some speculations are also given concerning the process of catalytic oxidation.

Keto-enol tautomerism: F. O. Rice. The reaction studied was $CH_3COCH_3 + I_2 = CH_3COCH_2I + HI$, in dilute aqueous solution. It is catalyzed both by H^0 and OH^1. The mechanism of this reaction and of keto-enol tautomerism will be discussed in the light of the following results: The velocity of the reaction in presence of buffer solutions has been measured and it was found that in a neutral buffer solution $(H+ = 10^{-7})$ the reaction went as fast as in 0.01 N HCl. The velocity fell as the H° concentration increased up to $H^\circ = 10^{-4}$ at which point the velocity was a minimum. This behavior may be explained by assuming that the catalytic activity of the OH^1 is 10^4 times that of the H° ion. If, however, we assume that dry H^0 and dry OH^1 are the catalysts, they may be present in minimum concentration when the total $H^\circ = 10^{-4}$. Hence at this point catalytic activity would be a minimum.

The application of catalytic reduction to the pyrimidine series: Elmer B. Brown and Treat B. Johnson. In a study of the application of catalytic reduction to the pyrimidine series using hydrogen in the presence of colloidal platinum or palladium it has been found that uracil and cytosine readily absorb hydrogen at 75° C. and two atmospheres pressure and yield quantitatively dihydrouracil. Dihydro-cytosine was not identified. Thymine and 4-Methyl-uracil are not reduced under similar conditions. Sodium, potassium, calcium and magnesium chlorides did not retard the progress of the reduction. Traces of sulphur compounds greatly retard the reduction process. Neither pepsin, trypsin nor gum tragacanth can be substituted for gum arabic as a colloid support.

The dehydration of alcohols: A. B. Brown and E. Emmet Reid: A study has been made of the composition of ethyl and butyl alcohols by passage over silica gel, thoria, blue oxide of tungsten and alumina at temperatures from 250 to 500 degrees. Complete analyses of the gases have been made. Alumina gives the best yields and the purest ethylene and butylene and the blue oxide of tungsten the next best. Silica gel is about as active as thoria and gives less aldehyde than thoria. Appreciable amounts of carbon dioxide are produced by all the catalysts, especially by thoria.

The catalytic condensation of acetylene with benzene and its homologues: **Joseph S. Reichert and J. A. Nieuwland.** In the presence of concentrated sulfuric acid and a mercury salt as a catalyst acetylene combines with benzene to form diphenyl ethane. The reaction is highly exothermic so that cooling is necessary. The best yields are obtained by maintaining a temperature of ten to twenty degrees C. A small amount of dimethylanthracenehydride is also formed in the same reaction by the condensation of two molecules of acetylene with two molecules of benzene. In a similar manner toluene, xylene, mesitylene and ethyl benzene were found to combine with acetylene to form the homologues of diphenyl ethane.

The catalytic combination of ethylene and hydrogen in presence of metallic copper: **Robert N. Pease.** The kinetics of the catalytic combination of ethylene and hydrogen in presence of metallic copper has been investigated at 0 degrees and 20 degrees, measurements of reaction velocity and of adsorption isotherms of ethylene, hydrogen and ethane having been made. The velocity is approximately proportional to the hydrogen concentration, but increases with decreasing ethylene concentration. Adsorption measurements show that all three gases are adsorbed, the order of adsorption at low pressures being ethylene, hydrogen ethane and at atmospheric pressure ethylene, ethane, hydrogen. The results indicate that both ethylene and hydrogen must be adsorbed before reaction can take place, but that ethylene is preferentially adsorbed from the reacting mixture. The temperature coefficient of reaction velocity between 0 and 20 degrees is 1.7 per 10 degrees. This makes it improbable that diffusion is of primary importance.

The rôle of the catalyst in reactions involving the carbonyl group: **Harold Hibbert.**

Some considerations about the reactivity of groups in benzene derivatives: **A. F. Holleman.** Results of the measurements of reaction velocities of chlorobenzenes, nitrobenzenes and chloronitrobenzenes with sodium methoxide are discussed.

A method for the estimation of the meta isomer in a mixture of ortho, meta and para nitrobenzoic acids: **A. W. Francis** and **A. J. Hill.** The method involves first a quantitative reduction of the nitro groups by titration with N/4 titanous chloride, followed by titration with a standard potassium bromide-bromate solution. The meta compound takes up three substituent bromine atoms, while the ortho and para isomers receive but two. The amount of the former may then be calculated after applying a small empirical correction. It is more rapid than most physical methods and may be applied directly to solutions, thus avoiding losses incurred by isolation of the substances. Investigations, designed to extend the generality of this method, are now in progress.

The bromination of 2-amino-p-xylene: **A. S. Wheeler** and **E. W. Constable.** Fisher and Windhaus state that in the bromination of 2-amino-p-xylene (formyl derivative) the halogen atom "probably" enters position 5. We have proved that this is the position occupied as follows: The bromination of the acetaminoxylene gives a new compound, flat needles, m. 186. Hydrolysis with hydrobromic acid gives the hydrobromide, scales, m. 245°. The Sandmeyer reaction converts this into 2.5-dibromo-p-xylene, m. 75°. The proof was made stronger by oxidizing the last compounds with nitric acid in a sealed tube to 2.5-dibromoterephthalic acid, m. 314 and conversion of the acid into its ethyl ester, m. 125°. The last three compounds are known.

The action of sulfur upon p-toluidine in presence of litharge. Thio-p-toluidine; its constitution and some new derivatives: **M. T. Bogert** and **M. R. Mandelbaum.** The interaction of sulfur and p-toluidine, in presence of litharge (or similar substances) at 140-145° results in the formation first of 3-mercapto-4-aminotoluene. This amino thio cresol then, through the oxidizing influence of the sulfur and litharge, unites with more p-toluidine to thio-p-toluidine, while smaller amounts are oxidized to the corresponding disulfide. The constitution of thio-p-toluidine is proven to be bis (2-amino-5-methylphenyl) sulfide, elimination of the amino groups giving di-m-tolyl sulfide, which latter was also prepared by direct synthesis from m-iodotoluene and m-thiocresol. Incidentally, some new methods of preparation are described, as well as various new derivatives of thio-toluidine.

The reactions of the formamidines XI. The 2-thio-4-thia solidones. Rhodanins: **F. B. Dains** and **S. I. Davis.** Rhodanine $S—CSNHCOCH_2$ and its 3-aryl-substitution products (aryl=phenyl, p-tolyl, etc.) contain a grouping CH_2 which shows the usual reactivity of methylene hydrogen. Other investigators have found that it condensed readily with aldehydes and in addition the present work has shown that it reacted readily with the diaryl formamidines and gave products of the type: (A) $S—CSNRCOC = CHNPh$, or (B) $S—CSNHCOC = CHNHPh$. B. contains the grouping—CSNH—which evidently exists also in the tautomeric form C—SH—N—. This was shown by the fact that the methylene substitution products $\underline{\mathrm{S—CSHN—COC}} = \mathrm{CHX}$, where X is an aryl or NH aryl, easily formed thio ethers with alkyl or benzyl halides, which have the constitution, $\underline{\mathrm{S—C—SRNCOC}} = \mathrm{CHX}$. This is in harmony with the behavior of the thio-imidazolones, previously described.

Production of imido thiol esters by the condensation of thio cyanides with resorcinol or phloroglucinol: R. J. Kaufman and Roger Adams. Many reactions have appeared in the literature tending to show that the cyano grouping in organic thiocyanates reacts similarly to the cyan grouping in nitrites. This similarity has been shown to exist also in the condensation of thiocyanates with resorcinol and phloroglucinol in the presence of hydrogen chloride and zinc chloride. Whereas the nitriles yield imido-hydrochlorides which hydrolyze to ketones, the thiocyanates yield imido thiol ester hydrochlorides having the following general formula: $1.3—(HO)_2C_6H_3(4)C(=NH—HCl)SR$. The reaction takes place with both aryl and alkyl thiocyanates. The imido thiol ester hydrochlorides, by the action of sodium bicarbonate, yield the imido thiol esters. These latter substances, upon treatment with alcohols, are converted into the corresponding imido oxygen esters, which in turn may be hydrolyzed to carboxylic esters. The imido thiol ester hydrochlorides may be hydrolyzed to thiol esters which, upon saponification, yield carboxylic acids.

The preparation of alkylguanidines: Ross Phillips and H. T. Clarke. Methyl iso-thiourea sulfate, a reagent recently diescribed by Arndt for the preparation of methyl mercaptan, reacts readily with aliphatic primary and secondary amines to yield the sulfates of mono and dialkyl guanidines in almost theoretical yield. This reaction does not take place with aromatic amines. Methylguanidine sulfate and dimethylguanidine sulfate form colorless crystals readily soluble in water but insoluble in alcohol.

The influence of sulphur on the color of azo dyes: D. G. Foster and E. Emmet Reid. A series of azo dyes has been prepared by coupling various alkyl ethers of o. amino-thio-phenol with standard intermediates with a view to contrasting the dyes containing sulphur and the sulphone group with the corresponding oxygen dyes. The colors of the dyes are related in the same way as in the corresponding para compounds, though the ortho are lighter. The methoxy group deepens the color more than methyl and the methyl-thio ether still more, while this effect is lost by oxidation to the sulphone.

A study of irreversible organic reductions: J. B. Conant and R. E. Lutz. The irreversible reduction of certain unsaturated compounds, aromatic nitro compounds and azo compounds has been studied in aqueous, alcoholic and acetone solutions. Each compound was tested with reducing agent of known potential, an electrochemical method being employed to determine whether or not reduction had occurred. The potential at which the irreversible reduction first occurred at an appreciable rate was thus estimated within fifty millivolts. The "apparent reduction potentials" thus determined for a series of compounds in acetone-hydrochloric acid were: $C_6H_5COCH = CHCOC_6H_5 = +0.270$, $C_6H_5COCH = CHCOOH = +0.080$, $HOOCCH = CHCOOH$ below -0.130; $C_6H_5N = NC_6H_5 = +0.360$, $C_6H_3(NO_2)_3 = +0.270$, $C_6H_4(NO_2)_2 = +0.162$; $C_6H_5NO_2 = +0.080$. The change in apparent reduction potential with change in P_H is approximately parallel to the change in potential of the quinones under similar conditions.

Diplumbic hexæthide, a new organometallic compound: Thomas Midgley, Jr., Carroll A. Hochwalt and George Calingaert. On heating any alloy of lead and sodium with ethyl iodide no reaction takes place unless water be present, when lead tetraethyl is formed. On treating this successively with hydrochloric acid and sodium hydroxide, first triethyl lead chloride and then triethyl lead hydroxide are produced. When this last compound is electrolyzed in alcoholic solution, a good yield is formed of an oil whose properties agree closely with the formula $Pb_2(C_2H_5)_6$. This compound is entirely different from that of Klippel, whose description indicates that he had undoubtedly produced lead tetraethyl.

Charles L. Parsons,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and twenty-ninth regular meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, April 28. The attendance included fifty-seven members of the society.

The secretary announced the election of twenty persons to membership and the entrance into the society since the February meeting of three additional members of the London Mathematical Society under the reciprocity agreement.

At the meeting of the Council, Professor Edward Kasner was elected a member of the editorial committee of the *Transactions*, as successor to Professor L. P. Eisenhart. Professor Eisenhart was elected to complete the term of service of Professor C. N. Haskins as representative of the society in the division of physical sciences of the National Research Council, Professor Haskins having asked to be relieved on account of ill health.

The secretary announced that the Cole prize fund had been augmented to more than one thousand dollars. The following committee was appointed to set the first prize problem and arrange the conditions of award: Professors H. S. White (chairman), H. F. Blichfeldt, L. E. Dickson, T. S. Fiske and W. F. Osgood. The first award may be as early as the annual meeting of 1927.

The following papers were read before the society at this meeting:

The resemblance between the ordinate of the periodogram and the correlation coefficient: W. L. Crum.

Birational transformations simplifying singularities of algebraic curves: G. A. Bliss.

Curvatures and the top: O. D. Kellogg.

Simplified proof of l'Hospital's theorem on indeterminate forms: E. V. Huntington.

Tables of Lagrangean coefficients, for interpolating without differences: E. V. Huntington.

A remarkable class of entire functions: J. I. Hutchinson.

On Newton's formulas for the sums of the powers of the roots of an algebraic equation: C. N. Haskins.

Invariants of the transformation of a differential form by analytic transformations. Preliminary report: O. E. Glenn.

Mutual induction of two square coils: T. H. Gronwall.

On Dirichlet's series with complex exponents: E. Hille.

Normal congruences and quadruply infinite families of curves in space. Second paper: J. Douglas.

Determination of all families of ∞^4 *curves in space in which the sum of the angles of every triangle is two right angles:* J. Douglas.

On the complete independence of the functional equations of involution: C. C. MacDuffee.

The Dirichlet problem for the sphere and its generalization; necessary and sufficient conditions: G. C. Evans and H. E. Bray.

Integro-differential invariants of one-parameter groups of Volterra transformations. Preliminary report: A. Michal.

A generalization of the Dirichlet problem: N. Wiener.

A new type of summability: N. Wiener.

On the location of the roots of Lamé's polynomials: J. L. Walsh.

Rods of constant or variable circular cross section: C. A. Garabedian.

A pendulum of varying length: F. H. Safford.

Note on a certain type of ruled surface: W. C. Graustein.

On certain difference equations: N. E. Nörlund.

Orthogonal systems of hypersurfaces in a Riemann space: L. P. Eisenhart.

Symmetric tensors of the second order whose first convariant derivatives are zero: L. P. Eisenhart.

Geometry of curved space without coordinates: G. Y. Rainich.

Normal congruences of curves in a Riemann space: H. Levy.

Linear tensor equations: P. Franklin.

A qualitative definition of the potential functions: P. Franklin.

Riemann spaces conformal to Einstein spaces: H. W. Brinkmann.

Einstein spaces mapped conformally on each other: H. W. Brinkmann.

Surfaces with orthogonal loci of the centers of geodesic curvature of an orthogonal system: M. C. Foster.

Trajectory surfaces: J. Lipka.

Geometric interpretation of the second differential parameter: J. Lipka.

Formulas for the greatest and the least variate under general laws of frequency or error: E. L. Dodd.

Singularities that may be added to those of curves of given order: T. R. Hollcroft.

On the quadratic ternary partial differential equations admitting Lie groups of orders 4 and 5: S. D. Zeldin.

On the approximate solution in integers of a set of m linear non-homogeneous equations in $n > m$ *unknowns, and the final form of Kronecker's theorem:* H. F. Blichfeldt.

Homogeneous first integrals of the geometry of paths: O. Veblen and T. Y. Thomas.

Isothermal surfaces with spherical lines of curvature in one system: T. H. Gronwall.

Extension of Tchebychef's statistical theorem: T. H. Gronwall.

The summer meeting of the society will be held at Vassar College, Poughkeepsie, September 6-8.

R. G. D. Richardson
Secretary

SCIENCE

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Science News VIII

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ONE HUNDRED AND FIFTY YEARS OF MUSEUM HISTORY[1]

WE have come together here to celebrate a dual anniversary—the anniversary of the founding of the Charleston Museum and the anniversary of the inception of the museum idea in the New World. That this idea has been a fruitful one is evidenced by the long roster of museums represented in this national association. It would be inappropriate for us to meet this year in any less historic place than Charleston.

In behalf of the American Association of Museums it is my duty and my privilege to pay homage to the broad vision of the founders of The Charleston Museum, to honor the city of Charleston for its steadfast preservation and nurture of the institution through the vicissitudes of a hundred and fifty years, and to congratulate the present generation of Charlestonians upon the youthful vigor of their venerable museum.

In behalf of the Charleston Museum it is but fitting that some of the more significant features of its history should be reviewed on its sesquicentennial anniversary.

The museum was founded in 1773 by the Charles-Town Library Society, to which belongs the credit of conceiving the museum idea, or at least of first giving it formal expression. This was done in a document so thoroughly worthy of the movement it initiated that I shall read it in full:

THE LIBRARY SOCIETY OF CHARLES-TOWN[2]

Taking into their consideration the many advantages and great credit that would result to this Province from a full and accurate Natural

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[1] Address delivered at the anniversary session of the American Association of Museums, in its eighteenth annual meeting, held at Charleston, S. C., April 4, 1923.

[2] *South Carolina Gazette* (Powell's) of March 22 and April 5 and 12, 1773. *South Carolina Gazette* and *Country Journal* of March 30 and April 6, 1773.

History of the same, and being desirous to promote so useful a design, have appointed a committee of their number to collect and prepare materials for that purpose.

That this may be done in the most complete and extensive manner, *they do now invite* every gentleman who wishes well to the undertaking, especially those who reside in the country, to cooperate with them in the advancement of this plan. . . . For this purpose, the Society would request such gentlemen to procure and send to them all the natural productions, either animal, vegetable, or mineral, that can be had in their several bounds, with accounts of the various soils, rivers, waters, springs, etc., and the most remarkable appearances of the different parts of the country.

Of the animal tribe they would wish to have every species, whether terrestrial or aquatic, *viz.*, quadrupeds, birds, fishes, reptiles, insects, worms, etc., with the best accounts of their customs and natural habitudes.

Of vegetables they will thankfully receive every kind, from the loftiest tree in the forest to the smallest plants of the fields. . . . A complete specimen of any tree or plant will be two small branches of each, one having the flower in full blossom and the other the ripe fruit. . . . At the same time the Society beg to be furnished with the best accounts that can be given of the uses and virtues, either in agriculture, commerce or medicine, of which such tree or plant is possessed—the soil in which it most commonly grows—the season in which it flowers and when it bears its fruit.

They would be glad to be furnished also with specimens of all the various fossils, minerals and ores, the different soils, earths, clays, marles, stones, sands, shells, etc., the productions of this Province, with the best accounts of their several natures, qualities, situations and uses.

The Society, in order that this design may be carried into immediate execution, have fitted up a museum for the reception and preservation of specimens of these several natural productions and have appointed Charles Cotesworth Pinckney and Thomas Heyward, Jun., esquires, with Alexander Baron and Peter Fayssoux, physicians, in *Charles-Town*, to receive them, to whom all letters of intelligence, specimens, etc., are to be addressed.

And they flatter themselves, that the evident utility of the plan will engage such a number of public spirited gentlemen to assist them that they will soon be able to make a considerable progress. . . . They will not only gratefully receive all such communications and apply them in the best manner they can for the above purposes, but the names of all such shall be recorded as promoters of and contributors to so useful a work.

Any expense that may be incurred by forwarding letters of intelligence, specimens, etc., to town the Society will cheerfully repay.

By order of the Committee,

JOHN MURRAY,
Chairman.

The purpose of a local museum could hardly be better expressed to-day and the importance of local collections needs to be stressed in all natural history museums.

In 1814 the Literary and Philosophical Society was incorporated in Charleston for the development of a greater museum. To this new body the Library Society, in 1815, generously transferred the museum, thus undoubtedly making possible a larger development than could have been expected of a subsidiary activity of the library.

In 1815 the state legislature and the city council "with a promptness and liberality which will forever redound to the credit,"[3] as the old record runs, made appropriations for the purchase of the extensive collections of Dr. Felix l'Herminier, who became the superintendent of the museum. This is the first record that I have found of the appropriation of money by a state legislature or a city council to any American museum.

During the next ten years the museum grew rapidly and acquired an astonishing popularity. In 1824 an editorial in the *Courier* says: "In these enlightened times, a public museum is as necessary an appendage to a city as a public newspaper or a public library."[4]

In 1826 the museum was "open every day from 9 o'clock and brilliantly illuminated every evening."[5] I think this period was one of the high spots in museum history.

In 1827, however, a movement to erect a building having failed, the Literary and Philosophical Society deposited the Museum with the new Medical College of the State of South

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[3] Shecut, J. L. E. W., Medical and Philosophical Essays, Charleston, 1819.

[4] The *Courier*, November 23, 1824.

[5] The *City Gazette*, most of the issues of January, 1826. An advt.

Carolina, under whose auspices it was developed for more than twenty years.

In 1850 the American Association for the Advancement of Science held its third meeting in Charleston, and at the session of March 16, Louis Agassiz suggested the desirability of establishing a larger museum in Charleston about the nucleus of the museum of the Literary and Philosophical Society. This is apparently Agassiz's first effort in museum development and is particularly interesting as a prelude to his great work for the Museum of Comparative Zoology at Cambridge.

Interest developed rapidly and at a meeting of the board of trustees of the College of Charleston on March 28 (almost exactly the seventy-seventh anniversary of the founding of the museum) a proposal was favorably received looking to the use of rooms in the College of Charleston for the museum. This plan was formally approved by the trustees on July 15, 1850, and was communicated to the city council for endorsement, since the city was expected to defray the maintenance of the museum. The minutes of city council were destroyed during the Civil War, but the communication of the trustees of the college fortunately was printed in the Charleston *Courier* of July 19, 1850, and contains the following indications of the plans for the museum:

> The yearly regular expenses therefore may be estimated at about fifteen hundred dollars and it is believed that at present that amount can not be raised by private subscription and, under existing circumstances, could only be permanently provided by an annual appropriation by the city. It is confidently believed that such an appropriation would be amply compensated by the advantages which a well regulated and well sustained museum would bring to the city. It would aid greatly in exciting and rewarding a spirit of research and accurate inquiry among all our students of natural history. It would furnish us with new and accurate information of the changes which have taken place in the different accessible strata of our state and of the inhabitants in all departments of nature, by which these strata have been successfully occupied. It would assist the agriculturalist in studying the nature of his soil and suggest the means of stimulating its fertility.
>
> It would bring us into direct relations with the distinguished naturalists of this country and of Europe and be a point of attraction to them under favorable auspices and, maintained with that zeal and ability which it would surely deserve, it would be an ornament and an honor to the city and to the state.

The application of the trustees was favorably received by city council and on August 28, 1850, an "Ordinance to provide for the appointment of a curator for the museum of the College of Charleston"[6] was duly ratified.

The City of Charleston was thus the first municipality in America to enter into a permanent supporting relation to a museum. It has faithfully maintained that relation to the present time. Charleston's example has been widely followed by other cities, notably New York, and the principle is now recognized as an exemplary one.

Surviving the war between the states, the museum continued to grow through the devotion of its curators. It was, however, too much an adjunct of the college to fill the rapidly growing functions of a public museum in the early years of the present century.

The city council responded to a new program for the museum with a generosity and appreciation in keeping with its tradition, increased its appropriations, and in 1907 provided the present building.

In March, 1915, the Charleston Museum was incorporated in the one hundred forty-second year of its age. The city reaffirmed its partnership. The work of the museum was expanded and the interest of the people broadened and deepened. In 1919 Mr. William M. Bird, a trustee, bequeathed the nucleus of an endowment and the County of Charleston became a new partner, levying a one-quarter mill tax for the benefit of the museum.

The history of America's first museum is filled with originality, perseverance, vigor and high promise. The museum holds a conspicuous place in the life of Charleston. Under the able leadership of the director its attendance in 1922 was over 50,000. In a city of only 35,000 white population this is a record probably never before equalled.

Parallel with this development of the Charleston Museum there is a complex history of museums in other parts of the United States. We may appropriately sketch the outline of this broader movement as a background for the vision that must fill our minds of the future of museums.

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[6] The *Courier*, August 31, 1850.

I have referred to the Charleston Museum as the first expression of the museum idea. It does not seem probable that it was the pattern of the museums which sprang up in other parts of the country. Rather, we must conceive of the idea as developing more or less independently and under somewhat different auspices in widely scattered places. The second American museum was the Peale Museum of Philadelphia. Since this had but a brief history we need not dwell upon it. The second oldest museum in existence is the East India Marine Society Museum, now a part of the Peabody Museum at Salem, Massachusetts. This was founded in 1799 as a repository for the curiosities gathered by ship captains of Salem from distant parts of the world.

The first half of the Nineteenth Century gave rise to a number of museums in connection with both learned societies and colleges. Among those may be mentioned the Pennsylvania Academy of Fine Art (1805), Bowdoin College Art Museum (1811), Academy of Natural Sciences of Philadelphia (1812), Allegheny College Museum (1820), Boston Society of Natural History (1830), Wesleyan College Museum (1831), and the Portland Society of Natural History (1843). The beginning of the National Museum in 1846 marks the culmination in the museum development of the period.

The founding of science museums by colleges and learned societies was a natural expression of the interest of the time in descriptive natural history. The displacement of that interest by the biology of the succeeding half-century, with its emphasis upon laboratory study of morphology and embryology, is the fundamental reason for the large number of neglected and inactive college museums to-day. It is essential that we recognize that these museums filled a vital place in the life of their time. Their deterioration was the result of fundamentally changed conditions. They are largely responsible for the widespread popular concept of museums as static and somewhat dreary things. One of the tasks in which we are making progress is that of changing this concept in the minds of the people.

The greatest and most active museums of America to-day, with few exceptions, have originated within the past fifty years and have had their phenomenal development within twenty-five years. A few examples may be given: American Museum of Natural History (1869); Metropolitan Museum of Art (1870); Museum of Fine Arts, Boston, (1870); New York State Museum (1870); Pennsylvania Museum (1876); Art Institute of Chicago (1879); Milwaukee Public Museums (1882); Brooklyn Institute of Arts and Sciences (1889); Field Museum of Natural History (1894); Worcester Art Museum (1896); John Herron Art Institute (1896); Carnegie Institute Museums (1896). Most of these museums are of a new type, being founded and supported either by private endowments or by municipal or state funds. There is a marked decrease in the number of new museums founded by colleges or by technical societies and museums are henceforth significant as public institutions.

The conception of museums as store-houses and research organizations, of interest principally to specialists, has been broadened to give equal importance to the interpretation of their subject matter to the public. This is the most significant advance in museum purposes and methods during the whole hundred and fifty years of museum history. It is making museums popular universities in a field of apparently endless possibilities.

SUMMARY

The Charleston Museum was the first museum in America. It was the first to take many of the most significant steps in the evolution of the museum idea. The same idea germinated, more or less independently, and expressed itself in somewhat different ways in other places. Four sources of support have been widely used: (1) learned societies; (2) schools, colleges and universities; (3) private endowments; (4) municipal, state or national funds. The first of these leads to museums of high technical value but not to the broader museum functions. The second is responsible for the largest number of existing museums, but this group functioned most fully during the Nineteenth Century and is to-day in a period of decline or eclipse. The third is the foundation of some of the largest and most influential modern museums, but does not enlist the full support of the people if the endowment is drawn from a single individual. The fourth is a reasonably satisfactory source, but subject to the usual weaknesses of government activities. The most successful foundation for the modern museum, broadly speaking, seems to be the combination of private endowments from many sources for the creation of the museum and municipal support for its operating expenses—the Charleston plan.

About fifty per cent. of American museums are devoted exclusively, or chiefly, to natural history; about twenty-five per cent. to history, and about ten per cent. to art. Approximately thirty-eight per cent. of these museums derive their financial support from schools, colleges and universities; thirty-five per cent. from societies or associations; fifteen per cent. from city governments; seven per cent. from private individuals or endowments exclusively; four per cent. from state government, and one per cent. from the national government.

These statistics do not indicate the relative importance at the present time of the subjects treated by museums, or the importance attached to museums by the various organizations that support them. It is not those museums that reflect past conditions, but those that hold promise of future service that are most significant. The half century in which we live may be confidently expected to see the expansion of the museum ideas that germinated during the second half of the Nineteenth Century. It should be our goal and our determination to secure national recognition of the sentiment expressed ninety-nine years ago in the editorial in the Charleston *Courier*, previously quoted: "A public museum is as necessary an appendage to a city as a public newspaper or a public library."

PAUL M. REA

CLEVELAND MUSEUM OF NATURAL HISTORY

FIELD EXPLORATIONS OF THE AMERICAN MUSEUM DURING THE YEAR 1922

THE American Museum of Natural History, deeply concerned with the rapid disappearance of the natural life and beauty of the world, among both the native races of men and the mammals of land and sea, is pushing exploration very hard at the present time, especially in Africa, Australia, southern and northern Asia and Polynesia. In the fifty-fourth annual report, issued May first, there is set forth a statement and summary of the scientific achievements and expenditures of the museum during the year 1922 which is recast in condensed form for the readers of SCIENCE.

These expeditions of 1922 represent an expenditure of more than a half million dollars for purely scientific work and about a half million for the extension of the results to educational institutions of the city and country; they represent 194,475 miles of travel during the single year; above all, they represent devotion and self-sacrifice in the interests of the museum on the part of the explorers and collectors which are beyond all praise. The work was made possible through extreme generosity on the part of members and friends of the museum, who in some instances financed the entire cost of an expedition and in others supplemented the funds of the museum which are devoted to this work.

The Third Asiatic Expedition, now in its third year, started in the spring of 1921 under the leadership of Roy Chapman Andrews, and results obtained thus far have exceeded expectations. In April of 1922 the expedition left Kalgan for Mongolia to continue work in zoology, geology, paleontology and geography as far as Urga, westward to the eastern extension of the Altai and Tian Shan Mountains and south to the frontier of Chinese Turkestan, a region including the most arid section of the Gobi Desert and rolling meadow-lands and foothills at the base of high mountains, some of which are covered with perpetual snow. On the way to Urga, about 260 miles northwest of Kalgan, fossil remains comparable to fossils found in Wyoming were unearthed—an epoch-making discovery because it throws light on the migration of animal life from Europe to America *via* Asia. While the fossil hunters were studying these beds, leader Andrews and the zoological branch pushed on to Urga and completed arrangements for the journey west of Urga into the region which was to occupy them for the summer.

In India two parties are enthusiastically making collections of great value for the museum; in the historic fossil-bearing formation of the Siwalik Hills Barnum Brown, under great difficulties, has secured fossil material, including mastodon and elephant skulls, of such importance as to raise the museum collection to the third position in this respect in the world. In the southwest the big game animals are being hunted for the museum by Colonel J. C. Faunthorpe, an A. D. C. to King George and a resident commissioner at Lucknow, and Mr. Arthur S. Vernay, who are responsible for the Faunthorpe Indian Expedition. The museum has provided a taxidermist, John Jonas, of Montana, and will defray the expense of transporting the material collected.

Carl E. Akeley's fourth expedition to Africa, from which he returned in March of 1922, yielded five specimens of gorillas of the Kivu country, the largest weighing 360 pounds, which will be mounted in a habitat group for the African Hall. James L. Clark, with Kenyon V. Painter, visited the Tanganyika country to procure material for a rhinoceros group, and R. T. Burge, of Los Angeles, is also expecting to collect for the museum on his present trip to Africa and India.

Extensive exchanges with various museums in Australia are enriching the museum collections through relations established by William K. Gregory during his visit to Australia. Among such material are a collection of skulls of Australian aborigines, a cast of the skeleton of the marsupial elephant *Diprotodon* and a rare nectar-eating phalanger *Tarsipes*. The field collecting was continued by Harry C. Raven, who with the cordial cooperation of government officials and museum and university men secured a representative collection of Australian mammals—kangaroos, wallabies, native bear, etc. Mr. Raven also collected mammals and marine birds in Tasmania..

During the year N. C. Nelson spent several months in western Europe studying prehistoric collections in the museums and in private hands and collecting material of the Paleolithic period. He also visited a number of new archeological sites in England, France and Belgium, making some excavations. Through previous journeys of Mr. Nelson, three journeys of President Osborn and one of Dr. McGregor, beginning in 1913, the museum has secured splendid collections of the archeology and prehistory of man in Europe, which will be displayed in the Hall of the Age of Man and the Hall of the Prehistory of Man.

The museum is hunting in Württemberg for the ancestors of the dinosaurs; in southern Württemberg Dr. F. von Huene is excavating for fossils at Trossingen and his results will be shared jointly by the Tubingen Museum and the American Museum.

Through field work conducted in the Azores and the Cape Verde Islands by José G. Correia the museum bird collections are enriched by several hundred specimens, particularly marine birds, including petrels, boobies, tropic birds and some of the rare insular species of land birds. The bird collections also continue to benefit by the Whitney South Sea Expedition in Polynesia, under the leadership of Rollo H. Beck. In the two years that the expedition has been in the field 3,851 specimens have been collected, nearly all new to the museum collections and many new to science, with 562 photographs and extensive field notes.

Southern Alaska was visited by P. E. Goddard, accompanied by Lieutenant G. T. Emmons and Dr. C. F. Newcombe of Victoria, B. C., for the purpose of collecting Indian totem poles and wood carvings for the Jesup Hall and for obtaining first-hand information for a handbook on the tribes of that region. A number of interesting specimens were secured.

South America contributed largely during the year to the museum collections and information. Herbert Lang made an extensive study of the fauna of British Guiana and later went up the Mazaruni River as far inland as Mount Roraima, making comparisons between the South American forests and savannahs and those of Africa, which he had previously studied. G. H. H. Tate and Herbert E. Wickenheiser collected mammals in Ecuador, where also Messrs. Chapman, Cherrie and O'Connell made a successful reconnaissance of the coast and mountains, collecting several species new to science and about a dozen not hitherto recorded from this locality. About six hundred specimens were collected and arrangements were made with native collectors to secure other birds from little-known parts of eastern Ecuador. The biological survey of Amazonian waters was continued by Harry Watkins in Peru, while Ernest Holt collected birds in the mountains of eastern Brazil.

G. K. Noble spent three months in Santo Domingo collecting reptiles and amphibians and studying their life histories. He secured several thousand specimens, including nine new species. He observed the life histories of many species and procured specimens and material for habitat groups of the largest tree frog in the world and the largest lizard in the Americas.

Within the United States geological studies were carried on by E. O. Hovey in Colorado, California and Oregon; by C. A. Reeds in New York state; and by E. A. Foyles in the Lake Champlain region. A reconnaissance trip during the summer was conducted through northwestern Nebraska southward to Pawnee Buttes by W. D. Matthew and Childs Frick, who observed chiefly the stratigraphy of these formations and secured a few specimens of rare fossil animals. A valuable collection of fossil mammals was secured by Albert Thomson near Agate, Nebraska; Messrs. Olsen and Miller collected fossils in the Bridger formation of Wyoming; Messrs. Mook and Kaisen worked in the Cretaceous of New Mexico, from which they obtained a new type of Horned Dinosaur discovered by Charles H. Sternberg. Valuable exchanges were arranged with the Colorado Museum of Natural History, and through the visit of Charles Lang to the museum of the University of California material to complete a mounted skeleton of the Giant Ground Sloth *Mylodon* from the Rancho La Brea deposits was secured.

Roy W. Miner, in cooperation with Frank J. Myers, continued his field studies in southern New Jersey in connection with the new Rotifer group, which will show the animals and plants of a half-inch portion of pond bottom magnified to an area five feet square. F. E. Lutz spent the summer near Boulder, Colorado, continuing the field work which he has been doing in connection with the wild bees of Colorado and carrying on investigations as chairman of the National Research Council committee on the biological relations between flowers and insects. Seven species, two new to science, were added to the list of about eight hundred different kinds of wild bees in Colorado. Through the generous cooperation of B. Preston Clark, Frank E. Watson collected about 11,000 specimens of insects, lower invertebrates, fishes and reptiles in Haiti and also enriched the museum exhibition and study series of insects by field work near New York City.

Work on the anthropology of the Southwest, which was commenced in 1909, was continued by Earl H. Morris, especially in Aztec, New Mexico. This work has followed exploration of the Pueblo Bonito through the gift of Mr. Frederick E. Hyde and Mr. B. T. B. Hyde, the results of which were published in 1920 in the volume on the Pueblo Bonito and furnish important data for comparative study of these cultures. This work has yielded results of great interest and the ruins have proved in many ways the most complete record of the past history of this region. It was early decided not to destroy these ruins but to preserve them and the excavation was carried on with utmost care, preservation proceeding step by step with the digging. As a result, the museum was able to present this monument of Aztec to the United States, in the name of Archer M. Huntington. Clark Wissler examined some archeological sites in New York State along the Hudson, where evidences of prehistoric occupation were discovered and some curious stone works uncovered. Arrangements have been made for more extensive excavation. Earl H. Morris, accompanied by Charles L. Bernheimer, explored part of southern Utah, located a number of heretofore unknown prehistoric ruins there which will be thoroughly examined in the near future and made a general reconnaissance of the Navajo Mountain region of New Mexico.

HENRY FAIRFIELD OSBORN

AMERICAN MUSEUM OF NATURAL HISTORY
MAY 29, 1923

THE EDWARD K. DUNHAM LECTURESHIP FOR THE PROMOTION OF MEDICAL SCIENCE

EDWARD KELLOGG DUNHAM died on April 15, 1922. He was a pathologist and bacteriologist whose training, as subsequent events were to show, was much in advance of his period.

Profiting in an unusual degree from his undergraduate studies at the School of Mines of Columbia University, he carried with him, first to the Harvard Medical School and later into his teaching and research, a proficiency in the fundamental sciences of mathematics, chemistry and physics possessed by few of his contemporaries.

The Edward K. Dunham lectureship has been established at Harvard University by his wife, Mary Dows Dunham, through a gift of $50,000 in conformity with the following provisions:

> It would be my hope, that in addition to other useful purposes, this Foundation would serve to bind closer the bonds of fellowship and understanding between students and investigators in this and foreign countries.
>
> The lecturers chosen under this Foundation should be eminent investigators and teachers in one of the branches of the medical sciences, or of the basic sciences which contribute towards the advance of medical science in the broadest sense.
>
> While I assume that the lecturers may be expected to be drawn chiefly from among the leaders of foreign medical research, it is my desire that the lectureship be open also to persons eminent in their respective subjects residing within the United States.
>
> The selection of the lecturers shall be determined by a suitable committee of the Harvard Medical School, of which the Dean of the Medical School is a member, the other members being chosen from departments of pathology, physiology, bacteriology, biochemistry and medicine, or their future equivalents.
>
> The lectures shall be given annually. The income of the fund is to be used in defraying the expenses of the lecturer and for an honorarium for the lectures.
>
> In the event of the lectures given under the Foundation being published, it is my wish that they carry a suitable inscription indicating that they were delivered under the Edward K. Dunham lectureship of Harvard University.
>
> The lectures are to be free and open to the faculty and students of the Harvard Medical School and College, and all other interested professional persons who may profit by them.

Of Dr. Dunham himself it may be said that the basic training which he enjoyed determined in a large measure the nature of his profounder interests and the character of his individual pursuits in pathology and bacteriology, subjects which he elected as his life's work.

The first fruits almost of his unusual preparation in chemistry came while he was still studying bacteriology in Koch's laboratory in Berlin, where he discovered the well-known "Cholera-red" reaction which has played and still plays a large and important part, not only in the identification of bacterial types, but also in the determination of their metabolic activities. It is again to be detected in his studies of the lipoids occurring in glandular organs, which he pursued actively for several years and at a period when their fundamental significance had not yet come to be appreciated.

While Dr. Dunham was a persistent student and investigator, he was not a prolific writer. This is a circumstance much to be regretted because it tended too much to limit the knowledge of his work and his pregnant points of view which he shared freely with his associates and intimate friends. It was he, for example, who discovered the spore-bearing propensity of the *Bacillus aerogenes capsulatus* or, as commonly called, the gas bacillus of Welch. This discovery revealed an important event in the life history of the bacillus and the large group of affiliated micro-organisms. But it did more than this, since it provided a new method of wide application. The discovery, moreover, was not accidental but arose out of a well-considered plan of study of the conditions—chemical and physical—surrounding the manner of growth, survival, etc., of the Welch bacillus. Likewise his studies of the meningococcus, undertaken while a member of the Board of Health Commission created during the epidemic of meningitis which prevailed severely during a decade beginning about 1904, had as their object not so much the identification of that micro-organism through its cultural characteristics as through its chemical effects. He determined the limits of its fermentative power over a wide range of carbohydrates and thus was enabled to bring about its separation from certain other diplococci with which confusion easily occurs.

This bias toward the more exact or mathematical, chemical and physical aspects of bacteriology and pathology is evident in all Dr. Dunham's investigations and appeared constantly in his expressed opinions on scientific questions. Its possession enabled him easily and in an altogther remarkable degree to turn from one kind of scientific pursuit to another and afforded him a versatility and a resource in experiment and in action which few enjoy. He became, through this circumstance and by virtue of an unfailing and exceptionally sympathetic nature and manner, a dispenser of knowledge and help to an ever-widening circle of scientific workers who drew freely on his rare stores of information and wisdom.

The great war engaged profoundly his emotions and his scientific faculties. He at once threw himself into those activities in which he was qualified to render service. No duty, no demand to aid was too severe for him to undertake with the full extent of his powers. His services on the "Empyema Commission," created by the Surgeon-General, and of which he was made chairman, were numerous and invaluable. No one could have devoted himself more unsparingly, more unselfishly and more skillfully to the unravelling of the intricate problems which arose or brought to their consideration so many and varied scientific resources. He approached the problem as pathologist, bacteriologist and chemist and later and in due course of events, as would the surgeon and therapeutist as well. This great undertaking, ramifying as it did along almost endless lines of causation, prevention, treatment, immediate and end results, claimed his last days and too often his last nights also, and preoccupied and absorbed him to an extreme degree. Fortunately, the manuscript covering this study has been brought almost to conclusion. That its publication will reflect credit on his efforts and honor on American medicine is the conviction of all who knew the nature and the extent of Dr. Dunham's labors.

Dr. Dunham was for many years professor of pathology in the Bellevue and University Medical College of New York City. On relinquishing this connection, a few years before his death, he became emeritus professor, continuing active by giving occasional lectures and in divers ways promoting the work of the college.

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH
NEW YORK CITY

SCIENTIFIC EVENTS

MEMORIAL TO SHACKLETON

THE following statement has been made public in England:

At a meeting held at the Mansion House on May 8 a committee was constituted with the object of promoting a national memorial to Sir Ernest Shackleton.

The voyages which he planned in the Nimrod, the Endurance and the Quest covered almost every side of Antarctic exploration. The history of the first two expeditions is the story, on the one hand, of originality and resourcefulness carrying him far beyond his predecessors, and on the other, of apparent failure triumphantly retrieved. In spite of the colossal risks undertaken, and the disasters faced and overcome, every man who sailed under Shackleton's direct command on either of these expeditions to the Antarctic was brought safely back; and had Shackleton lived to carry out the program of the Quest a new chapter in the history of the exploration of the Southern Seas might well have been the result.

We feel strongly that, in the case of one who displayed such brilliant qualities of courage and leadership, it is a national duty that his memory should be perpetuated by some suitable memorial of a permanent nature, so that his example should be forever an incentive to the youth of the Empire.

For this object we anticipate wide sympathy and support; but there is another basis for our appeal. It is known that Sir Ernest Shackleton was a successful lecturer, and that he received large sums for film rights and for his books, but the money he obtained from these sources was never sufficient to meet the obligations he had himself incurred in endeavoring to complete the finance of his various expeditions. The Endurance expedition, though providing probably the greatest feat of successful leadership in the history of exploration, left Shackleton heavily in debt at a time when his sole thought, directly he returned, was to participate in the Great War.

The second object, therefore, for which we appeal for funds is to provide for the education of his children, and to take his place in supporting his mother. The balance that remains, after meeting these two obligations, will be devoted to the encouragement of exploration.

Checks for donations may be made payable to the National Provincial and Union Bank of England, Limited, for credit of "Shackleton Memorial Fund," and may be paid into any branch of that bank, or may be sent direct to the honorary treasurer, Mr. Howard Button, C.B.E., Messrs. Chantrey, Button, and Co., 61-62, Lincoln's Inn-fields, London, W.C.2.

Yours truly,

Curzon of Kedleston
Invernairn
Edward C. Moore,
Lord Mayor
F. Becker
Philip L. Brocklehurst
Martin Conway
Robert Donald
E. R. G. R. Evans
Rupert Gwynne
Alfred Hutchison
F. C. Learmonth
G. S. Lysaght
Charles Maynard
Hugh Robert Mill
Ralph Richardson
John Q. Rowett
Charles Sarolea
J. Scott Keltie
A. E. Shipley
George Smith
Janet Stancomb-Wills
Frank Wild
A. F. Yarrow
Howard Button,
Hon. Treasurer.
Kenneth M. Chance,
Hon. Sec.
J. M. Wordie,
Hon. Sec.
Ronaldshay,
President

London, May 24, 1923

THE BEQUESTS OF DR. LUDWIG MOND[1]

By the death of Mrs. Mond, widow of Dr. Ludwig Mond, which occurred on May 16, the Royal Society becomes the beneficiary, under Dr. Mond's will, of a considerable sum of money in furtherance of scientific objects. Dr. Mond, as is well known, was a distinguished chemical technologist. He worked under Kolbe at Marburg, later under Bunsen at Heidelberg, finally becoming domiciled in England, where he secured the friendship of the leaders of British science, as also of many persons in literary and artistic circles. He was elected a fellow of the Royal Society in 1891, and died in 1909. The provisions of his will relating to gifts to science provided for the payment to the Royal Society, free of duty, of 50,000*l*, the income to be employed in the endowment of research in natural science, more particularly, but not exclusively, in chemistry and physics, by means of rewards for new discoveries and pecuniary assistance (including scholarships) to those pursuing scientific investigations, and in supplying apparatus and appliances for laboratories and observatories and in such other manner as the Royal Society should decide to be best calculated to promote scientific research. There was also a proviso that the Royal Society's council might allocate amounts for the publication and circulation of reports and papers communicated and assist the preparation and publication of catalogs and indexes of scientific literature which the society might have engaged in or might undertake in the future. To the University of Heidelberg a like sum was left, and for kindred purposes. Certain financial contingencies entailed that four years might elapse after Mrs. Mond's decease before these two bodies entered upon absolute ownership; notwithstanding, the legacies were to carry four per cent. interest per annum until paid up. It may be recalled that at the Royal Society's anniversary meeting of 1910 the then president referred to Dr. Mond in the following terms:

> The Royal Society has good cause to cherish his memory as that of a genial fellow, who took an active interest in its affairs, affording it at all times the benefit of his business experience, and ever ready to aid financially any of its enterprises which seemed to him to stand in need of assistance. By his will also he has left a munificent benefaction whereby the society will ultimately be enriched.

ZOOLOGICAL LECTURES AT THE UNIVERSITY OF MICHIGAN

A series of zoological lectures was arranged for the second semester at the University of Michigan. The primary purpose of the series was to provide, for advanced students of zoology, an outlook on the whole field that could not be gained in any other way. To this end the speakers were invited to discuss in a semi-technical fashion the large aspects of biology in which they were most directly interested. The lectures proved admirably fitted for this purpose and were well attended by students and members of the faculty representing not only the other sciences but the humanities as well. The list of lectures and their topics follows:

Geological history of the mammals: W. D. Matthew.

The blood as a physico-chemical system: L. J. Henderson.

Adaptations of insects; economic aspects of entomology: L. O. Howard.

Modifications of developmental rate and the structural response: C. R. Stockard.

The oestrous cycle as a means of analyzing structural change: C. R. Stockard.

Some of the recent work on mutants in drosophila; Development and the particulate theory of inheritance: T. H. Morgan.

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[1] From *Nature.*

Genetic problems in the protozoa; Crossing-over: H. S. JENNINGS.

Experimental study of longevity. I. Environmental factors. II. Inheritance: RAYMOND PEARL.

The neuromotor system of protozoa; The life cycle of protozoa with reference to certain fundamental aspects of evolution: C. A. KOFOID.

The genetic foundation and the balanced character of sex; The limits of action of sex hormones: F. R. LILLIE.

The chromosomes in relation to the individual; The chromosomes in relation to the race: C. E. MCCLUNG.

Physical and chemical characteristics of lake waters; The biology of lakes: CHANCEY JUDAY.

As a secondary function, the series served to introduce important phases of biology to the general public. A special group of evening lectures, semi-popular in their nature, was arranged. That these non-technical lectures fulfilled their purpose was evidenced by the interest aroused on every hand. The speakers and their subjects in this semi-popular series were as follows:

Dinosaurs: W. D. MATTHEW.

The fitness of the environment: L. J. HENDERSON.

The warfare against insects: L. O. HOWARD.

The origin of human types and the influence of internal secretions: C. R. STOCKARD.

Genetics and development: T. H. MORGAN.

Can we observe evolution in progress? H. S. JENNINGS.

The problem of population growth: RAYMOND PEARL.

Amoeba and man: C. A. KOFOID.

The unity of life: C. E. MCCLUNG.

The productivity of lakes: CHANCEY JUDAY.

FIELD EXCURSION OF OHIO GEOLOGISTS

THE geological section of the Ohio Academy of Science held its annual field excursion on May 25, 26 and 27, in Muskingum County, Ohio. The party assembled at Newark at noon on the twenty-fifth and that afternoon was devoted largely to archeology as shown by earthworks near Newark and the great flint quarries on Flint Ridge. Dr. W. C. Mills, director of the Archeological and Historical Society of Ohio, was the guide for this part of the trip.

The geological excursion proper was on the twenty-sixth and twenty-seventh and Mr. Wilber Stout, author of Bulletin 21, Geological Survey of Ohio, on the Geology of Muskingum County, was the guide during these two days. The rocks studied include the entire Pennsylvanian system and the basal fifty feet of the Permian and more than thirty of the named members of the Ohio geological column were seen. In addition certain Quaternary deposits used as molding sands were examined and some very interesting topography involving several erosion cycles was seen.

Fifty people were present on the afternoon of May 25 and about thirty-five on the twenty-sixth and twenty-seventh. The organizations represented include the Geological Survey of Ohio, the Soil Survey of Ohio, the Ohio State University, Western Reserve University, Denison University, Miami University, Antioch College, Muskingum College, the Dayton High School, the University of Michigan, the University of West Virginia. The trip was made by automobiles and was under the management of Dr. J. Ernest Carman, Ohio State University, vice-president for geology of the Ohio Academy of Science.

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

DR. E. P. LEWIS, professor of physics in the University of California, has been elected president of the Pacific Division of the American Association for the Advancement of Science, *vice* Dr. E. C. Franklin, resigned, whose duties as president of the American Chemical Society precluded his serving at the Los Angeles meeting in September. President Lewis will preside at the Los Angeles meeting and deliver an address, the subject of which will be announced later.

The general sessions at Los Angeles will open with a research conference on Monday, September 17, during the luncheon hour, which will be prolonged to permit reports from the Riverside Citrus Experiment Station, the Scripps Institution for Biological Research, the California Institute of Technology and the University of Southern California. General discussion will follow the presentation of reports.

President Lewis's address will occur at a public reception to be held Monday evening, September 17, in Bovard Auditorium, University of Southern California.

An interesting feature of the general sessions will be a symposium on eclipses and relativity, in which noted astronomers and physicists will participate. The preliminary announcement giving further details of the arrangements will be issued about June 15.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE CRILE, of the Western Reserve University Medical School, was elected president of the American Surgical Association at the recent Cleveland meeting.

DR. HARVEY W. WILEY, president of the United States Pharmacopeial Convention 1910-1920, has been elected an honorary member of the Pharmaceutical Society of Great Britain. This society, like the United States Pharmacopeial Convention, is charged with the duty of keeping the pharmacopeia up to date.

SECRETARY OF WAR WEEKS has announced the award of the Distinguished Service Medal to C. H. MacDowell, for service as head of the chemical branch of the War Industries Board during the war. Mr. MacDowell is now president of the Armour Fertilizer Works, Chicago.

WE learn from *Nature* that Professor L. Cayeux, Paris; Professor John M. Clarke, director of the New York State Museum; Professor H. Douvillé, Paris; and Professor Waldemar Lindgren, Massachusetts Institute of Technology, have been elected foreign members of the Geological Society, London. Among the foreign correspondents elected are Professor R. A. Daly, Harvard University; Professor J. F. Kemp, Columbia University; and Dr. F. E. Wright, Geophysical Laboratory of the Carnegie Institution.

MR. A. F. BASSET HULL has been elected president of the Linnean Society of New South Wales. J. P. Hill, professor of zoology and comparative anatomy in the University of London, and J. T. Wilson, professor of anatomy in the University of Cambridge, formerly professor in the University of Sydney, have been elected honorary members of the society.

PROFESSOR FRANK S. CAREY, of the University of Liverpool, retires at the end of the academic year after thirty-seven years' service as professor of mathematics.

AT the annual meeting of the New Haven Branch of the American Society of Mechanical Engineers on May 21 tribute was paid to Professor L. P. Breckenridge, of Yale University, who retires this year from active teaching, after forty years of service. Professor Breckenridge addressed the meeting on "The past and future of engineering." Fred J. Miller, past president of the American Society of Mechanical Engineers, presented Professor Breckenridge with an illuminated testimonial signed by all the members of the New Haven Branch. A binocular microscope, the gift of all the members of the mechanical-engineering department of Yale University, was presented to him at luncheon earlier in the day.

DR. CHARLES I. ROBINSON, chief chemist in the research laboratory of the Bayway refinery of the Standard Oil Company, at Elizabeth, N. J., retired on May 5, after thirty-seven years of continuous service and will receive an annuity. A dinner in his honor was given by his associates on May 9.

AFTER twenty-six years of service with the Solvay Process and Semet-Solvay Companies, Syracuse, New York, Alexis C. Houghton has resigned his position as chief chemist, to enter the employ of the Bakelite Company, New York City, where he will have charge of the phenol plant.

MR. M. AUROUSSEAU, petrologist at the geophysical laboratory of the Carnegie Institution of Washington, resigned on May 15 to join the scientific staff of the American Geographical Society, New York City.

DR. L. O. HOWARD, chief of the Bureau of Entomology of the United States Department of Agriculture, is in Europe attending the meeting at Paris of the Eleventh International Congress of Agriculture, of which he has been elected a vice-president.

DR. P. I. WOLD, professor of physics at Union College, has accepted an invitation from the Rockefeller Foundation to spend a year as visiting professor of physics in China on behalf of the China Medical Board. Dr. and Mrs. Wold will leave this country about the middle of July and will have their headquarters in Tientsin.

DR. A. C. SPENCER has been granted leave of absence for a month from the United States Geological Survey to do professional work in Cuba.

MR. K. C. HEALD, geologist, of the United States Geological Survey, is on leave of absence for several months to give a course of lectures on petroleum geology at the University of Chicago.

PROFESSOR MADISON BENTLEY, head of the department of psychology at the University of Illinois, is lecturing upon psychology during the intersession of the summer session of the University of California. He is spending a year's leave of absence from Illinois in research and writing at the University of California.

DR. MORTIMER E. COOLEY, dean of the Colleges of Engineering and Architecture, University of Michigan, and president of the Federated American Engineering Societies, delivered the commencement address at the Armour Institute of Technology on May 31. His subject was "The responsibility of education." On this occasion Dr. Cooley was given the honorary degree of Doctor of Science.

JOHN LYLE HARRINGTON, president of the American Society of Mechanical Engineers, delivered a series of five lectures at the University of Texas from May 21 to 24. Mr. Harrington's subjects were: "The relation of the engineer to America's further development," "The part of the engineer in the advance of civilization," "Movable bridges," "The design of industrial plants" and "After graduation what?"

DR. CHARLES ZELENY, of the University of Illniois, lectured at the University of Kentucky before the Kentucky Chapter of the Society of the Sigma Xi on May 25, on "Some phases of research on heredity."

AT the annual meeting of the Institute of Physics held in the rooms of the Royal Society on May 30, Sir Joseph Thomson gave the presidential address. He has recently visited the United States and discussed the position of industrial research here in physics.

THE Huxley lecture at the University of Birmingham was delivered on June 7 by Sir Arthur Keith, whose subject was "The origin of the British people."

OXFORD UNIVERSITY has authorized the presentation of an address to the Universities of Paris and Strasbourg on the occasion of the celebration of the centenary of the birth of Louis Pasteur.

A NOVEL feature of the meeting of the British Association at Liverpool, to be held from September 12 to 19, will be a scientific exhibition at which there will be exhibits of apparatus in connection with each section of the association and others showing recent advances in applied science.

AFTER a visit to the Brooklyn Institute of Arts and Sciences on June 2 and seeing the need for extension by Mayor Hylan, it was voted at a meeting of the committee of the whole of the Board of Estimate of New York City to recommend the appropriation of $1,050,000 for the construction of two wings to the buildings. The amount was $100,000 more than the institute had asked for. The committee also recommended, subject to the approval of Aldermanic President Murray Hulbert, who was not present, an appropriation of $86,000 for the construction of a third story on the city aquarium, the amount to include finishing the front of the structure and fireproofing the building.

A LETTER from the State Epidemiological Institute in Warsaw, Poland, announces the establishment of a new medical publication: *Journal of Experimental Medicine,* which will provide a medium for original publications for Polish scientific men, now completely lacking. One thousand subscribers are required, of which number only 240 are available at present. It is hoped that Polish physicians in this country and also libraries will subscribe or help in some suitable way. Those interested should forward their names and addresses to Dr. Casimir Funk, 437 West 59th Street, New York City. Medical publications who have Polish physicians among their subscribers are requested to insert this notice.

THE next meeting of the American Electrochemical Society will be held in Dayton, Ohio, on September 27, 28 and 29, 1923. The plans for this meeting include: A symposium on electrochemistry of gaseous conduction, which is in charge of Dr. Duncan MacRae, research laboratory, Westinghouse Lamp Company, Bloomfield, New Jersey; a symposium on recent progress in electrolytic refining, Chairman F. R. Pyne, United States Metals Refining Company, Carteret, New Jersey. An innovation at this meeting will consist of round table discussions on the following four subjects: "Electric furnace brass foundry practice," "Organic electrochemistry," "Chlorine," "Electroplating." Trips to local plants will be made.

Dr. Edmund Otis Hovey, curator of the department of geology and invertebrate paleontology in the American Museum of Natural History, will sail from Vancouver, B. C., on June 29, for Sydney, Australia, where he will attend the meetings of the second Pan-Pacific Scientific Conference as the representative of the museum. He will also represent the New York Academy of Sciences. The conference is to be held in Melbourne and Sydney from August 13 to September 3. Dr. Hovey will visit various places of geological interest in Australia and on his way back to America will make a tour of the most important geological localities in New Zealand. One purpose of the trip is to obtain information which will be of value in the construction of additional geological relief models at the museum. Another purpose is to establish exchange relations with the museums in New Zealand and to extend those now enjoyed with the museums of Australia.

The aggregate receipts of the German-Austrian Fund (Graham Lusk, treasurer) amounted to $2660.26, subscribed to by eighty-eight American scientists in sums ranging from $5 to $450. The money was distributed among thirty-three German-Austrian medical laboratories which were designated by the donors in sums ranging between $25 to $300. The account has been closed and has been audited by Dr. Rufus Cole. The following letter is a typical response: "Please accept my most grateful thanks for your most generous gift. Almost daily I think with gratitude of the help which my department has received from America. I am fully aware of the fact that, but for this help, it would have been impossible to continue our classes and scientific investigations."

UNIVERSITY AND EDUCATIONAL NOTES

Announcement has been made of the merger of the Moore School of Electrical Engineering, provided for in the will of the late Alfred Fitler Moore, and the School of Electrical Engineering of the University of Pennsylvania. The new school will be known as the Moore School of Electrical Engineering and will have the income from a fund of $1,500,000.

Dr. William D. Cutter, for the past several years secretary of the New York State Board of Medical Examiners, has resigned to become dean of the New York Postgraduate Medical School and Hospital.

The following promotions and appointments in the clinical staff of Stanford University School of Medicine, San Francisco, are announced: Dr. William P. R. Clark, professor of medicine in charge of tuberculosis work; Dr. Leo Eloesser, clinical professor of surgery; Dr. Philip K. Gilman, clinical professor; Dr. John A. Bacher, professor of surgery in diseases of the ear, nose and throat; Dr. Harry L. Langnecker, professor of orthopedic surgery and in charge of physiotherapy; Dr. James A. Cutting, clinical professor of medicine to conduct classes in psychiatry.

Assistant Professor Lloyd L. Smail, of the University of Washington, has been appointed to an assistant professorship of mathematics in the University of Oregon.

Dr. Carl A. Murchison, professor of psychology at Miami University, has been appointed full professor of psychology at Clark University. He will fill the vacancy caused by the resignation of Dr. Kimball Young.

Professor Leonard Bairstow has been appointed as from September first next to the Zaharoff chair of aviation tenable at the Imperial College of Science and Technology, London. He has been head of the aeronautical department of the National Physical Laboratory and since 1920 has been professor of aerodynamics at the Imperial College.

DISCUSSION AND CORRESPONDENCE

THE PENNSYLVANIAN OF NORTH CENTRAL TEXAS

When I was at Lota, Chile, I found the federal gendarmerie guarding the property of the Chilean Coal Company—an entirely private concern—with the zeal displayed by the guards at Potsdam before the all highest fled to Holland, and it was impossible to even look at the dumps without telegraphic permission from the directors in far distant Valparaiso. I suppose the so-called manager would have fainted if permission had been asked to go in the mines.

E. DeGolyer, in a recent number of *Economic Geology*, has made a plea for greater cooperation between economic and other geologists, which is both timely and well put. Companies employing economic geologists, which are to a large extent oil companies, have abundant means for securing the cooperation of most geologists, but the geologist, working upon some special problem, finds it well-nigh impossible to obtain needed information or paleontologic material from the companies, when such help would in no wise affect the company interests.

I could, of course, enumerate several notable exceptions to this generalization and recognize fully the commercial necessity for holding back certain types of information and material, but generally a company will hold data of no present or future value, or even destroy records if they decide to abandon some contemplated development, seemingly actuated by eighteenth century business secrecy, or by the motive that what cost them good money should not be permitted to benefit any one else.

Oil companies are not the only ones imbued with this notion and I know of no more notable example than the Cerro de Pasco Mining Company, which has maintained a corps of geologists for some years and has presumably carried out the only detailed studies of a considerable area in the whole Andes. Much of the information accumulated is of no special value to the company but would be of the greatest importance in stratigraphic and historic geology. For example the fossil plants associated with the company's coal development at Goyllarisquisca would be of the utmost importance in their bearing on plant migrations and the geographic relations between North and South America during the Cretaceous, and yet a letter addressed to their chief geologist on this subject several years ago has never even been acknowledged.

Since its appearance nearly two years ago I have looked in vain for a review or appreciation of Bulletin 2132 of the University of Texas entitled "Stratigraphy of the Pennsylvanian formations of North-central Texas" by Frederick B. Plummer and Raymond C. Moore, having seen but one very brief notice. This work owes its existence to the enlightened policy of the Roxana Petroleum Corporation and it seems to me that their policy can not be commended too highly. Although not qualified to pass an expert opinion on the subject matter, I would like to indicate its general character and the intrinsic evidence of meritorious work that it exhibits.

It comprises a rather full discussion of the stratigraphy of the Pennsylvanian rocks of North Central Texas, an area of approximately 7,000 square miles. These rocks include the formations of the Bend, Strawn, Canyon and Cisco groups with a total thickness of over a mile and the report includes a full account of previous work, local sections, finely executed plates of characteristic fossils and is accompanied by a geologic map of the whole region on a scale of 1/187,500, or approximately three miles to the inch, representing the combined results of all of the Roxana geologists who have worked in the area. There is a chapter on the structure of the Pennsylvania rocks, a summary of the physical history of Pennsylvania time in the region and a summary chapter on correlation, which is discussed at length in connection with the description of the stratigraphic units throughout the body of the work. The report closes with a table showing the distribution of the fauna and a detailed list of fossil localities. The former lists 1 Protozoan, 3 Porifera, 17 Coelenterata, 3 Vermes, 18 Echinoderma, 39 Bryozoa, 94 Brachiopoda, 57 Pelecypoda, 69 Gastropoda, 43 Cephalopoda, 7 Trilobita and 3 Pisces. This enumeration will vouch for the extensive nature of the paleontologic evidence upon which the author's conclusions are based.

The authors dissent from the conclusions of Girty and others that any part of the Bend series is of Mississippian age and correlate it with the Caney and Wapanucka of Oklahoma and the Morrow of Arkansas. Admitting the late Mississippian character of some of the Barnett shale brachiopods and goniatites, the presence of *Fusulina*, *Leda bellistriata* and the goniatite genera *Glyphioceras* and *Gastrioceras*, as well as the general stratigraphic and paleogeographic relations, make out a good case for the Pennsylvanian age of these beds.

The work is illustrated by many halftones, sketch maps and diagrams and fully measures up to the highest standards. The authors are to be commended on the excellence of their work which, with the liberal policy of their company already referred to, sets a standard that other companies might well imitate to the lasting advantage of geologic science.

Edward W. Berry

The Johns Hopkins University

THE STATUS OF TEREDO BEACHI AND TEREDO NAVALIS

I have so far refrained from commenting on the efforts of Professor Kofoid and his students to discredit the validity of my *Teredo beachi*. A review in the *Nautilus* for April, 1923, on page 140 of Robert Cunningham Miller's paper on the "Variations in the shell of Teredo navalis in San Francisco Bay," University of California Publication in Zoology, Vol. 22, No. 2, pp. 293-328, bears the following statement which is a slightly abbreviated rendition of Miller's statement on page 25 (317) "The local varieties, including *T. beachi* Bartsch, have not been found sufficiently differentiated to warrant their being classed as subspecies, much less as species."

This, I feel, makes it necessary for me to protest lest my silence be construed as concurrence in the opinion of my West Coast critics.

The paper in question is a beautiful intensive study of *Teredo beachi* Bartsch and, barring the summary, in which the systematic status of this species is discussed, a splendid piece of work. It is unfortunate that the author in question, as well as Professor Kofoid himself, has not made an equally intensive study of the European *Teredo navalis*, which I have been unable to find in American waters, before publishing this summary, for I am certain that had they so done, they themselves would have become acquainted with the characters that differentiate the *navalis* group from the *Teredo morsei* group, to which *Teredo beachi* belongs.

In *Teredo navalis*, the denticles on the anterior median area have but a single cusp. In the *Teredo morsei* group they are multicuspid. That at once differentiates the two groups and there are hosts of other characters that separate the members of these groups into specific or subspecific elements.

The only member of the *navalis* group that I have found so far in American waters is the New England shipworm, *Teredo novangliae* Bartsch. All the other true *Teredos* seen belong to the *morsei* group, both on the east and the west coast of America.

Paul Bartsch

United States National Museum

NICOTINE AS A POULTRY VERMIFUGE

Following the work of Herms and Beach in 1916, the University of California Agricultural Experiment Station has been more or less continuously interested in the use of tobacco and tobacco products as a vermifuge for the intestinal worms of poultry, *Ascaridia galli* Schrank 1788 (= *A. perspicillum*). Work carried on during the past year and a half with hundreds of hens has shown that commercial tobacco dust containing from 1½ to 2 per cent. nicotine if fed in the mash in quantities equalling 2 per cent. by weight of the latter over a period of one month would remove from 98 to 100 per cent. of these worms. The results have also demonstrated that from 80 to 85 per cent. of the cecum worms, *Heterakis gallinæ* Gmelin (=*H. papillosa*, = *H. vesicularis*) are removed by this treatment. The tobacco dust must be mixed with the mash at intervals not exceeding one week on account of the volatility of the nicotine in the presence of air.

Diluted nicotine sulfate administered to the birds directly in quantities sufficient to remove the worms is decidedly toxic. Mixed with the mash or drinking water it renders them so distasteful that the birds will not eat or drink properly. However, by mixing the nicotine sulfate with Lloyd's Alkaloidal Reagent, a selected fuller's earth, perfect elimination of the intestinal worms has been secured, although the cecum worms remained unaffected. The method employed was that of mixing the nicotine sulfate (40 per cent. nicotine) at the rate of 6.6 cc. to 16 grams of the reagent. This mixture was then placed in gelatine capsules (No. 2), one of which when filled weighed approximately 350 milligrams and constituted a treatment. The Lloyd's reagent holds the nicotine as long as the mixture is in an acid medium, liberating it when it becomes alkaline. The small intestine is slightly acid at its anterior end but becomes rapidly alkaline at about the point where the intestinal worms are present in the greatest numbers. Thus the nicotine is liberated at the desired point for the maximum effect on these worms. Rectal injections of nicotine sulfate (40 per cent. nicotine) diluted at the rate of 1 cc. to 200 cc. of distilled water and administered in 10 cc. injections remove approximately 85 per cent. of the cecum worms. Stronger concentrations are decidedly toxic, a 1 per cent. mixture administered in the same manner causing an immediate paresis and death in about ten minutes.

STANLEY B. FREEBORN

CALIFORNIA AGRICULTURAL
EXPERIMENT STATION

TO DEMONSTRATE PROTEIN GRAINS

ONE of the most effective ways to demonstrate the presence of protein grains in the cellular tissue of a seed is by making a freehand razor section of the meat of a Brazil nut. Place the section on a glass slide, and flood it several times with ether. If enough ether is used to cause it to flow over the edges of the slide the dissolved fat will collect on the under side of the slide where it is easily wiped off. After treating with ether flood with absolute alcohol; replace the alcohol with xylol and mount in xylol, or if a permanent mount is required mount in balsam. The Brazil nut is rich in its peculiar kind of protein, and by this method several of the grains may be seen in nearly every cell.

E. R. SPENCER

AMEBOID BODIES ASSOCIATED WITH HIPPEASTRUM MOSAIC

IN a recent publication[1] the writer described and pictured certain bodies in the cells of corn plants suffering from mosaic disease. Since the bodies are confined to diseased portions of the plant, it was suggested that they might be of etiological significance.

Those who are working on the mosaic disease problem will be interested to know that similar bodies have now been found in the light green portions of mosaic leaves of *Hippeástrum equéstre* Herb. This plant belongs in the Amaryllidaceae and is not closely related to corn. Its leaves which are thick and soft are well suited for cytological studies. The mosaic pattern shown by *Hippeástrum* is quite different from that of corn. The intracellular bodies associated with this disease will be described in detail in a future paper.

L. O. KUNKEL

EXPERIMENT STATION OF THE HAWAIIAN
SUGAR PLANTERS' ASSOCIATION,
HONOLULU, T. H.

SCIENTIFIC BOOKS

Laboratory Manual of Colloid Chemistry. HARRY N. HOLMES. John Wiley & Sons, Inc. XII + 127 pp.

THIS volume was written at the suggestion of the Colloid Committee of the National Research Council. Colloid chemistry is growing rapidly and this book is a welcome addition to the colloidal literature. There are 186 experiments, from which the student is expected to select the ones suited to his particular needs.

There are first of all methods of preparation and purification followed by illustrative examples of peptization and coagulation, of protective colloids and solvated colloids. The measurement of surface tension and viscosity are treated in brief chapters. In a chapter on adsorption several experiments are given on silica gel. The use of the ultra-microscope receives two pages. Experiments on hydrogen ion concentration and osmotic pressure and Donnan equilibrium are not included. Descriptive matter preliminary to the experiments makes the work easy reading and stimulates the use of the author's bibliography.

In classical chemistry we have used quantitative measurements to the greatest advantage, melting point, boiling point, solubility, percentage composition and molecular weight and they give the firmest sort of a foundation upon which to build a science. Colloid chemistry can hardly be called an exact science until it can offer similar quantitative measurements and exact definitions. (Too much have we followed the good old practice, "*Wo ein Idee fehlt steckt man ein Wort hinein.*") We have a stupendous nomenclature, but do substances in the colloidal state have a measurable melting point (or something analogous to it)? We say that nitrocellulose is more soluble in acetone than in amyl acetate; but do colloids have a measurable solubility (or some analogous property)? Of what possible use is the measurement of the viscosity of a colloid if the viscosity is always a function of the particular shearing stress used and therefore not a definite property? When do colloidal solutions pass into true solutions? Gels are elastic, but how elastic? And what is a gel? Dr. Holmes quotes, page 43, with approval the interesting statement, "There is a definite connection between the boiling point, the viscosity and the heat of dilution of a solution of salt and its solvent power for cellulose." How is this solvent power measured, what is this connection and why does it exist? Several experiments in this manual are pretty without teaching much. In other cases the lesson is lost because chemists are in disagreement. It seems obvious to the reviewer that there is great need for more fundamental work on colloidal materials. And perhaps it is not too daring to hope that chemists will be found in agreement when the generalizations are sufficiently broad and far-reaching. Such work should serve not only as a basis for sound theory but offer simple quantitative experiments for instructional purposes of the highest pedagogical value.

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[1] Bul. Exp. Sta., H. S. P. A., 3: 44-58 (1921).

Eugene C. Bingham

SPECIAL ARTICLES

PHASE REVERSAL IN PROTOPLASM AND EMULSIONS

The reversal of phases in oil emulsions by electrolytes was discovered by Clowes.[1] Clowes worked with olive oil emulsions in which the aqueous phase was a soap solution, the soap being added directly or formed through saponification of the oleic acid in the olive oil by an aqueous phase of NaOH. Clowes found that, when the salt of a bivalent cation ($CaCl_2$) is in excess in the aqueous phase, the emulsion is of the water-in-oil type, and when the hydroxide of the monovalent cation Na is in excess, the emulsion is of the oil-in-water type. Clowes came to some very interesting and far reaching conclusions on the basis of his experiments. It does not appear that he worked with emulsions in which the stabilizing agent is some colloid other than soap.

Clowes saw in the behavior of oil and water emulsions (in which soap is the emulsifier) an explanation of changes in protoplasmic permeability. It is now believed (by some biologists) that monovalent cations increase permeability of the plasma membrane, while bivalent cations decrease permeability. The hydroxide of the monovalent cation Na produces in an oil emulsion (with a soap stabilizer) a system in which the continuous phase is water. Such a system would be readily permeable to water soluble substances. Salts of bivalent cations, such as $CaCl_2$, produce an emulsion in which oil is the continuous phase. Such a system would be impermeable to water soluble substances.

On the basis of the similarity of the reactions of oil emulsions and of protoplasm to mono- and bivalent cations, Clowes has conceived of living protoplasm in contact with water as a system which is, within the protoplasmic mass, a dispersion of proteins, lipoids, etc., in water, and, at its surface, a system of the reverse type, in which water is dispersed in an external continuous fatty or lipoid phase. Clowes does not, however, regard the surface layer of protoplasm as a system in which the aqueous phase is wholly discontinuous, but rather as a system in which the continuous lipoid phase is permeated by water channels, *i.e.*, as an emulsion which is near the reversal point.

Clowes has assumed that the stabilizer active in the supposed protoplasmic emulsion is either soap or a substance which is like soap in its reaction to mono- and bivalent electrolytes. While soaps are present in protoplasm it does not seem likely that they are the emulsifier which determines the behavior of the supposed living emulsion when other possible emulsifiers such as proteins and lipoids are present in much greater quantities.

I had the pleasure of discussing phase reversal in emulsions with Mr. Hatschek, of London.

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[1] Clowes, G. H. A., "Protoplasmic equilibrium," *Jour. Phys. Chem.*, 1916, xx, 407-451.

Mr. Hatschek called my attention to the fact that if the emulsifier in an oil emulsion is some colloid other than soap, for example, gum arabic, the emulsion will not reverse when a bivalent electrolyte is added to it. With the kind permission of Mr. Hatschek I have repeated and extended his preliminary experiments.

The manner of making the stabilizers and the emulsions, with also the methods employed in determining the type of system, will all be fully described in a subsequent publication.

Oil emulsions in which sodium oleate or sodium stearate is the emulsifier are of the oil-in-water type and are reversible with $BaCl_2$.

Oil emulsions with casein, gliadin, cholesterin, or cephaelin as the aqueous phase, are of the water-in-oil type and are reversible with NaOH.

Oil emulsions in which saponin (senegin, smilacin), gelatose, gum arabic, albumin, lecithin, or a plant extract is the emulsifier, are oil-in-water systems which are *not* reversible with $BaCl_2$.

It is of interest to note that of three proteins, all present in protoplasm, the most abundant one, albumin, does not permit reversal, while the two others do; and of two lipoids, both constituents of living matter, one, lecithin, does not, and one, chloresterin, does permit reversal. Further, the plant extract (obtained by grinding and pressing fresh spinach), which one might expect to approach somewhat the chemical make-up of protoplasm, does not permit reversal.

Who can tell what the emulsifier in the supposed living emulsion actually is?

Since the hypothesis of Clowes rests on the assumption that the emulsifier in protoplasm is of that type which forms an emulsion which is reversible with $BaCl_2$ or NaOH, and since certain of the substances here experimented with as emulsifiers, are very abundant in protoplasm but form emulsions which are not reversible with $BaCl_2$ or NaOH, one is forced to conclude that, in view of the fact that we are totally ignorant of the actual nature of the active emulsifier in living matter, a theory of the mechanism of permeability changes which is based on the behavior of only one group of emulsions, must be regarded as a purely speculative hypothesis which rests on very uncertain evidence.

It is of further interest to note that NaCl will not reverse any of the reversible emulsions here studied, yet it is this salt which causes (in the opinion of some investigators) such a pronounced increase in the permeability of protoplasm.

Quite aside from the experimental facts here given, it should be pointed out that the hypothesis of Clowes, like so many other interesting speculations on protoplasmic behavior in general and on permeability changes in particular, rests on two very fundamental assumptions (in addition to the one above discussed) in support of which there is no substantial evidence.

It is assumed by Clowes, and indeed by most biologists as well, that protoplasm is an emulsion in which a reversal of phases is of common occurrence. The emulsion hypothesis of protoplasmic structure is still adhered to by many biologists in spite of the fact that there is in all *physical chemistry no conclusive* evidence that any lyophilic colloid, of which protoplasm is one, is a liquid-liquid system. That the dehydrated lyophilic colloids starch and cellulose are crystalline has been shown to be true by the work in Roentgen ray spectography of Herzog. Although this does not necessarily tell us what the hydrated colloid is like, the consensus of opinion among colloid chemists seems to be that the dispersed particles of the hydrated colloid, in a gelatin sol for example, are solid. In the process of hydration there apparently takes place a breaking down of larger crystalline aggregates into smaller ones, which may even approach the gelatine molecule in size. I believe that I am not misinterpreting the writings of McBain, Freundlich, Proctor[2] and Bachmann when I state they are of this general opinion.

Regardless of the physical nature of the colloidal particles—and after all, as Hatschek has pointed out, the distinction between liquid and solid becomes somewhat vague with particles approaching ultramicroscopic dimensions—there is no evidence that a reversal of phases takes place in the process of gel formation from the sols of lyophilic colloids. On the contrary, the work of Bachmann and Zsigmondy and of Mc-

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[2] Proctor, H. R., The structure of elastic jellies, *Phys. and Chem. of Colloids, Rep. Faraday Soc. and Phys. Soc.*, London, 1921, 40-43.

Bain has shown that in gelatin and in soaps, and therefore probably in many other if not all lyophilic colloids, *there is no reversal of phases in the formation of a gel,* but merely an aggregation of the colloidal particles—the dispersion medium in the sol is still the dispersion medium in the gel. The conception of a reversal of phases in the process of gelation owes its origin to the earlier supposition that the lyophilic colloids are liquid-liquid, "emulsoid" systems, an idea which is not now held by such chemists as Donnan, Freundlich, McBain and Zsigmondy. One wonders, therefore, how far we dare go in our phase reversal speculations on the mechanism of permeability changes and similar vital phenomena.

The full account of the experimental data here briefly reported will include a discussion of the remarkable behavior of the emulsion with a gelatose emulsifier. This is an emulsion of the oil-in-water type and is reversible, in the *same* direction with the hydroxide of either the bivalent cation Ba or the monovalent cation Na, but not with the salt of either cation. There will also be published data on the possible influence of acidity on phase reversal. That pH value is a factor in phase reversal is apparently true in certain cases, but that it is the determining factor in other cases is certainly not true. H-ion concentration must affect the ability of an emulsion to reverse through acting on the emulsifier—possibly the hydration power of the emulsifier—consequently, the effect of pH will differ in emulsions with different emulsifiers, and this the experiments show to be true.

William Seifriz

Osborn Botanical Laboratory,
Yale University

ACTIVE HYDROGEN BY THE ACTION OF AN ACID ON A METAL

Evidence for the formation of active hydrogen from its positive ion in an acid has been negative. The reports of the latest workers in this field, Wendt and Landauer[1], show that there are certain difficulties to be met. The main one is to eliminate the moisture that accompanies a rapid evolution of hydrogen and at the same time not destroy the active hydrogen if any were formed. If the gas stream were too low a velocity the active component would decay before reaching the sulfur. Then if the velocity were too high the moisture carried over would form a protecting film on the powdered sulfur and prevent the reaction between the two to form hydrogen sulfide.

During the work on the activation of hydrogen by corona discharge it was found by Wendt and Grubb[2] that active hydrogen combines with pure nitrogen to give ammonia. This method of testing for active hydrogen can be used to good advantage where moisture is carried along with the evolved hydrogen, since the spray does not prevent the contact of active hydrogen and the nitrogen.

If hydrochloric acid or sulfuric acid is dropped upon metallic magnesium suspended in such a way that the metal is at no time immersed or partly covered with any large portion of liquid, the drop of acid can react with the metal in the shortest possible time. This gives off hydrogen very rapidly, in fact, almost explosively, and with a minimum quantity of spray. If this evolved hydrogen is brought in contact with pure nitrogen it is found that ammonia is formed readily. The active hydrogen was then passed through a plug of glass wool before coming in contact with the pure nitrogen. The activity of the hydrogen still persisted as shown by the formation of ammonia. Therefore, the activity of the hydrogen cannot be due to ions or atomic gas. But Langmuir[3] has shown that monatomic hydrogen does not react with nitrogen to form ammonia. In view of this fact, if we allow pure nitrogen to escape at the surface of the magnesium where the hydrogen is evolved we find a maximum quantity of ammonia formed. The amount of ammonia formed increases with an increase in the rate at which the acid is dropped upon the metal. This of course means that the amount of the active component varies with the velocity of the gas stream.

If the acid is dropped on the metal very slowly and the evolved hydrogen passed through glass wool before coming in contact with nitrogen, no ammonia is formed. This indicates that the active hydrogen has reverted to the ordinary before meeting the stream of nitrogen. The life of the active gas seems to be not longer than two minutes. This checks very closely with the life of triatomic hydrogen formed by other methods.

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[1] Wendt and Landauer, *Jour. Am. Chem. Soc.*, xlii, 930, 1920; *Ibid*, xliv, 510, 1922.

[2] Wendt and Grubb, *Ibid*, xlii, 937, 1920.

[3] Langmuir, *Ibid*, xxxiv, 1324, 1912.

These results seem to substantiate the theory of Wendt and Landauer, namely, that triatomic hydrogen ought to be produced wherever atomic hydrogen is evolved. It is reasonable then to expect that a higher per cent. of active hydrogen would be found in the gas evolved from the surface of the metal than in the molecular hydrogen subject to electronic bombardment in a discharge tube. In the former all the hydrogen evolved goes through the atomic state while in the latter case only a very small amount of atomic gas may exist at one time. The discharge would also destroy some of the active variety.

The preliminary results to determine the per cent. of activation are in harmony with this theory. Further work is in progress to determine the quantitative relations of some of the factors involved.

A. C. Grubb.

University of Saskatchewan

SLIDE HOLDERS FOR OVERCOMING A DEFECT IN ATTACHABLE MECHANICAL STAGES[1]

Those employing attachable mechanical stages no doubt have encountered, the same as the writer, an unsatisfactory feature in their construction leading to frequent annoyance and delay in examining slides. This relates to the portions of the stage between which the slide is clamped. Instead of resting all but in contact with the stage of the microscope, they frequently lie in a plane sufficiently above the same to permit slides, especially the thinner ones, to become wedged beneath, thus interfering with a free movement of the stage. Stages undoubtedly present a range of variations in this respect. The writer has found the defect present to a certain degree in all stages used by him thus far, belonging to two makes.

The devices or slide holders here described are designed to obviate the difficulty. They are designed for a Spencer stage, but there is no reason why they should not be readily adapted to other makes.

The one shown in Figure 1 was made from No. 20 brass wire. It is a little shorter and somewhat broader than the slide to be carried. The upward projecting loops at *a*, *b*, and *d* should be tilted inward a little. They serve as supports for the back and right edge of the slide and also prevent the holder from becoming wedged beneath the stage in the same manner as slides. The end of *c* should be bent up very slightly to avoid wedging. The portions of the back of the holder having contact with the mechanical stage should be flattened with a file to give good contact and prevent the holder from slipping up. This holder is very readily made with no more tools than a round and a flat-nosed pair of pliers. The ends of the wire should be joined by being clamped in a thin metal sleeve. The holder should be straightened and made to lie perfectly flat by testing it out on a table or some other plane surface.

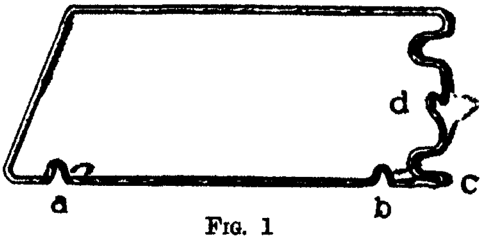

Fig. 1

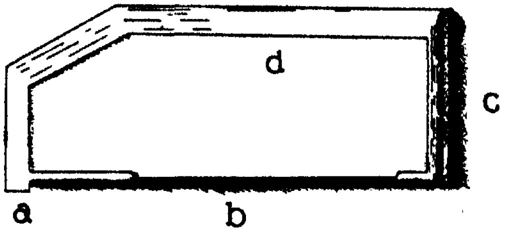

Fig. 2

The design shown in Figure 2 was cut from sheet brass of about the thickness of the above No. 20 wire. Its size is such that the end of the slide is flush with that of the holder and the front edge reaches to *d*. The edges *b* and *c* are first turned up to provide support for the back and right edge of the slide. These are then cut down to a height slightly exceeding the thickness of a slide. The edge at the point *a* should not be turned up but permitted to project very slightly beyond the back line, thus furnishing a secure contact with the back of the stage. This holder is more rigid than the first but requires more time and equipment to make it.

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[1] From the Department of Animal Pathology of the Rockefeller Institute for Medical Research, Princeton, New Jersey.

The left front end of the holders is formed to give space to the slide clamp.

The use of the holders alters the relation of the slide to the condenser by somewhat less than a millimeter, but this has not been found objectionable for ordinary work.

H. W. Graybill

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY. II.

The action of ultra violet light upon di-ketones: C. W. Porter. Diacetyl, $CH_3.CO.CO.CH_3$, when exposed to the radiation of a mercury arc lamp, decomposes with the production of ethane and carbon monoxide. Acetone may be an intermediate product; but acetone, under similar treatment, yields the same decomposition products. Benzil, $C_6H_5.CO.Co.C_6H_5$, in the solid or in the molten state is not decomposed by u. v. l. When vaporized and exposed to u. v. l. it slowly decomposes, forming benzophenone, carbon monoxide and a charred residue. In dry benzene solution benzil is not affected by light. An aqueous solution of benzil, in absence of air, yields benzoic acid, benzaldehyde and benzoin. Benzilic acid is not produced. Solutions of benzil in mixtures of alcohol and water yield the same products. In the presence of oxygen a water-alcohol solution of benzil (2 g. per liter) yields benzoic and salicylic acids. The reaction is completed within twelve hours.

Motion picture demonstrations of laboratory apparatus: H. T. Clarke.

The determination of mucic acid: E. O. Whittier. Mucic acid, tartaric acid or racemic acid may be determined in acid solution by oxidation with excess of standard potassium permanganate solution at boiling temperature, followed by a back titration with standard oxalic acid and standard permanganate. The relationships between these acids and permanganate are not stoichiometric, due to formation of some formic acid. Oxalic acid and mucic acid may be precipitated together quantitatively as calcium salts, dissolved and determined in the presence of each other, the oxalic acid being titrated at 50°C., the mucic acid at 100°C.

Dipropargyl methylene ether: Herbert H. Guest. This communication is a preliminary description of the preparation and properties of the methal of propargyl alcohol, and the attempt, so far unsuccessful, to utilize this acetal in the synthesis of the higher acetylenic alcohols of the type $RC \equiv C—CH_2OH$. Bis (2.3 dibromopropyl) methylene ether (A) $(CH_2Br—CHBr—CH_2O)_2—CH_2$ viscous oil $b_{10mm.}$ 220° was prepared by the action of a 2 per cent. HCl solution of 2.3 dibromohydrin on paraformaldehyde, and also by the use of anhydrous $FeCl_3$ and $CaCl_2$, respectively, as catalysts. Bis (2 bromoallyl) methylene ether (B) $(CH_2 = CBrCH_2O)_2CH_2$, oil $b_{10mm.}$ 135—40°C, from A by the action of finely powdered KOH in Et_2O solution. Di propargyl methylene ether (C), $(CH \equiv C—CH_2O)_2—CH_2$, oil $b_{10mm.}$ 75—80°C. was obtained in 50 per cent. yield from either A or B by heating with 4 mols. KOH dissolved in 4 vols. EtOH at 100°C. C reacts with Et Mg Br with evolution of C_2H_6 and formation of an oil insoluble in Et_2O. It gives an insoluble Ag salt $(AgC \equiv C—CH_2O)_2CH_2$ which explodes on heating and reacts very slowly with Na. These metallic derivatives of C were treated under varying conditions with alkyl halide, *e.g.*, C_4H_9Br in the attempt to form $(C_4H_9C \equiv C—CH_2O)_2CH_2$, but without any evidence of this reaction taking place.

The reaction between aryl esters of sulfonic acids and organomagnesium halides: Charles H. Meyers and Henry Gilman. In connection with a study of methods for the introduction of aryl groups, an investigation is being made of the reaction between aryl esters of various acids, organic and inorganic, and organomagnesium halides. It has been found that when aryl esters of aromatic sulfonic acids are used the chief products are sulfones.

Secondary aliphatic—aromatic arsines, C_6H_5-AsRH: C. Shattuck Palmer. This new series of arsines has been prepared by the action of alkyl halides on an alcoholic solution of the sodium derivative of phenylarsine, C_6H_5AsNHa. The products are colorless oils, which fume strongly in the air, but are not spontaneously inflammable. They are oxidized by air to a mixture of arsine oxide, $C_6H_5R\ As—O—AsRC_6H_5$, and arsinic acid, $C_6H_5RAsO_2H$, in which the latter constituent is present in much the larger proportion. With halogen arsine halides, C_6H_5RAsX are formed, and with alkyl halides, quaternary arsonium halides, $C_6H_5R_3AsX$. The reaction with secondary arsine halides, $R_2As\ Cl$ and $RR'AsCl$, has made possible the preparation of several previously unknown types of cacodyls.

Arsenated N—arylamino alcohols (By title): CLIFF S. HAMILTON. Ethylene chlorohydrin reacts with sodium arsanilate to give p-arsono-2 anilino-ethanol. Its sodium salt separates from alcohol in colorless crystals. By treating the arsonic acid with sodium hydrosulfite the corresponding arseno-compound is prepared. In a similar manner, trimethylene chlorohydrin reacts with sodium arsanilate to give p-arsono-3 anilino-propanol. Its sodium salt and the corresponding arseno derivative have been prepared. Other compounds are in the course of preparation.

A new photochemical color reaction (with demonstrations): LAWRENCE W. BASS AND OSKAR BAUDISCH. It has been found that a mixture of bromoform, iodoform and indol, which is stable in the dark, is very sensitive to diffused daylight or electric light, giving a deep red color in a few seconds. Because of the rapid color change in daylight, the reaction is particularly valuable for various photochemical lecture experiments. At the same time the reaction may be used as a sensitive test for indol.

The syntheses of some derivatives of the tetrahydro benzo-furane ring: A. E. OSTERBERG AND E. C. KENDALL. Thyroxin is a tetrahydro derivative of indol. Compounds which are tetrahydro derivatives of benzo-furane with the double bonds in the molecule bearing the same relationship as in thyroxin have been prepared. The chemical and physical properties of these compounds are described. Their reaction toward halogens, the ease with which the lactone and ester groups saponify and their stability toward oxidation and alkalis are discussed.

Acetyl-benzoyl derivatives of o-hydroxybenzylamine and o-aminobenzyl alcohol: L. CHAS. RAIFORD AND E. P. CLARK. In work previously reported from this laboratory (*J. Am. Chem. Soc.*, 41,2068 (1919); 44,1739 (1922) and 45,469 (1923)), it has been shown that when 2-acetylaminophenol is benzoylated in accordance with the Schotten-Baumann method, the benzoyl radical attaches itself to nitrogen, while acetyl migrates to oxygen, but that this rearrangement does not take place when para derivatives are involved. In continuation of this work and particularly on account of the results obtained by McConnan and Titherley and Auwers and collaborators, in which it was found that acetyl wandered from oxygen (bound to the nucleus) to nitrogen (situated on a side chain), the behavior of the derivatives of o-hydroxybenzylacetamide and its isomer o-acetylaminobenzyl alcohol have been examined. No migration of acetyl was observed but, instead, two isomeric acetyl-benzoyl derivatives were isolated in each case.

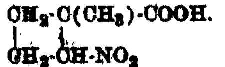
The reduction of benzalpinacoline: G. A. HILL AND C. S. SPEAR. Benzalpinacoline was treated with a variety of reducing agents and yielded three compounds, a high boiling point liquid, a monomolecular reduction product melting at 142 degrees and a dimolecular reduction product melting at 208.5 degrees. The liquid, a ketone, the only substance formed in catalytic reduction, was synthesized and is omega-benzylpinacoline. The solid melting at 142 degrees is presumably the corresponding secondary alcohol, but attempts to establish its structure were unsuccessful. The other compound is 2, 2, 9, 9, tetramethyl, 5, 6, diphenyl decandione, 3, 8. It was synthesized from the hydrochloric acid addition product of benzalpinacoline.

The mercurization of methylene blue: LYMAN CHALKLEY, JR. Attempts to mercurize methylene blue in the ordinary way have been failures. The proposed explanation has been that methylene blue probably forms such a stable complex with mercuric acetate that the concentration of mercuric ion is reduced below the value necessary for mercurization to proceed readily. Therefore, mercurization with a large excess of mercuric acetate was tried. It was found that benzoyl-leuco-methylene blue could be mercurized if about three molecules of mercuric acetate were used. The work upon methylene blue itself is not complete, but small yields of two organic mercury derivatives have been obtained.

Structure of isocampholactone: P. K. PORTER WITH W. A. NOYES. When isocampholactone is heated for some days with moderately strong nitric acid, the two principal products formed are nitroisocampholactone and a lactone acid:

$O_2N\text{-}C_8H_{13}\text{-}CO$ and $HOOC\text{-}C_7H_{11}CO$.
|......O..| |......O....|

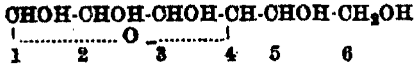
This lactone acid gives an amide which on treatment with sodium hypobromite is converted to a ketone acid $HOOC\text{-}C_7H_{11}{=}O$. This ketone on treatment with methyl magnesium iodide regenerates isocampholactone and also forms another acid which is probably the trans hydroxy acid which might be expected. This series of reactions demonstrates that isocampholactone contains methyl groups in the 1, 2, 3 positions instead of the 1, 2, 2 positions of camphoric acid. Nitroisocampholactone on treatment with an alkali gives, almost quantitatively, acetone and a nitro acid which probably has the structure,



$CH_2\cdot C(CH_3)\cdot COOH$ / $CH_2\cdot CH\cdot NO_2$. The work on the acid is not, however, completed.

The biological and chemical significance of gamma sugars: J. C. Irvine. The paper deals historically with the accumulation of evidence showing that reducing sugars can react in isomeric forms which differ in the position occupied by the internal oxygen ring. The general expression "gamma sugars" has been applied to the varieties in which the ring is displaced from normal stable position and the reactions of these sugars proceed with a facility which distinguishes them sharply from ordinary forms. No gamma sugar has been isolated in the free state, but their properties are indicated by the reactions of their methylated derivatives, several examples of which will be described. The suggestion is put forward that the elaboration of sugars in plants and their subsequent utilization by animals depend primarily on the transient formation of gamma sugars and not on the stable isomerides which constitute our standard examples of aldoses and ketoses.

A survey of the glucose molecule with reference to the formation of disaccharides and polysaccharides: J. C. Irvine. If the molecule of glucose is considered in the light of its capacity to form derivatives such as disaccharides and polysaccharides, it is clear from the results of recent research that attention must be focussed on two positions, indexed as 1 and 5 in the following formula:

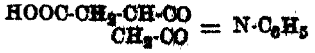


$$\begin{array}{llllll} CHOH\text{-} & CHOH\text{-} & CHOH\text{-} & CH\text{-} & CHOH\cdot & CH_2OH \\ 1 & 2 & 3 & 4 & 5 & 6 \end{array}$$

The No. 1 position, which constitutes the reducing group, takes part in the formation of glucosides and of non-reducing disaccharides such as sucrose. On the other hand, position 5 is involved in the formation of certain reducing disaccharides as, for example, lactose and cellobiose. In the case of the polysaccharides which are based on glucose, both of the hydroxyl groups (1 and 5) take part in the coupling, the best example being provided by cellulose in which no other linkage is present. Precisely the same structural feature is present in starch and in glycogen, where at least one maltose residue is attached to glucose through positions 1 and 5. This dissection of the function of each hydroxyl group in glucose serves to illustrate the simplicity and uniformity of the linkages involved in complex natural carbohydrates.

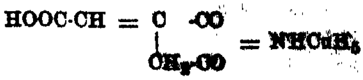
The oxidation of mannitol, sorbitol and dulcitol: Carl W. Holl and W. L. Evans. These hexitols were oxidized with alkaline and neutral potassium permanganate at 25, 50 and 75 degrees. The final reaction products were carbon dioxide, oxalic and acetic acids. Oxalic acid reaches a maximum value and the carbon dioxide a minimum value at about 0.1 N alkali. In studying the mechanism of these reactions, 1-arabitol, d- and l-arabinose were also oxidized under the same conditions as the hexitols. No difference was detected in the amounts of the reaction products obtained in the arabonic series at a given alkalinity, the final products being the same as those obtained in the hexitols. The following compounds and mixtures were also oxidized: Glycerol, glyceric aldehyde (solid), erythritol and glycollic acid, 1-arabinose and formaldehyde.

The aniline derivatives of citric and aconitic acids: E. B. Brown and J. R. Bailey. Pebal prepared the so-called citranilic acid, to which has been assigned the structure



$$\begin{array}{r} HOOC\text{-}CH_2\text{-}CH\text{-}CO \\ CH_2\text{-}CO \end{array} = N\cdot C_6H_5$$

In a previous paper before the organic section of the society we reported experiments aimed at the preparation of the isomeric citranilic acid by the action of aniline on methylene citric anhydride, with subsequent hydrolysis of the methylene anhydride. This method of preparation gives a substance different from the Pebal compound, but under certain conditions the two products yield identical reaction products. We find that the two compounds with PCl_5 give the same aconityl anil and with $C_2H_5OH\text{-}HCl$ the same ethyl citranilate. This ester with alcoholic ammonia yields first an amide anilide ester of citric acid, which on further reaction with ammonia gives a diamide anilide of citric acid. With alcoholic KOH the ester gives a potassium salt of an anilide ester of citric acid and with PCl_5 there is produced an anil ethyl ester of aconitic acid. Skinner and Ruhemann prepared an aconityl anil to which is assigned the formula



$$\begin{array}{l} HOOC\cdot CH = C\ \text{-}CO \\ \qquad\qquad\quad\ \ | \\ \qquad\qquad\ \ CH_2\text{-}CO \end{array} = NHC_6H_5$$

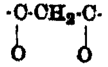
while W. Bertram made the corresponding methyl and ethyl esters. Our aconityl anil, its methyl ester made from this by $CH_3OH\cdot HCl$ and the ethyl ester prepared as described above, all differ from the corresponding derivatives to which reference has been made. We do not wish to advance structural formulas for the different substances involved in our work until further investigation has cleared up certain doubtful points.

Dimethylcyclopentenealdehyde: R. H. Read and Harold Hibbert. The structure of the aldehyde produced by the electrolytic reduction of crotonaldehyde has been established by its synthesis from the latter through the intermediate products b-brombutyraldehyde diethyl acetal and the tetra ethyl acetal of 3.4 dimethyl hexanedial.

The preparation of the benzilmonoximes and a monotropic modification of gamma benzilmonoxime: **Frederick William Atack and Alice Harrington Atack.** In the course of an attempt to prepare the third isomeride of benzilmonoxime, which should exist in accordance with Atack's theory of the structural isomerism of oximes (J. C. S., 1921, 119, 1175), the existence of a monotropic modification of gamma benzilmonoxime has been noted. Alpha benzilmonoxime has been prepared by Forster and Dunn (J. C. S. Trans., 1909, 95, 431) by the interaction in pyridine solution of benzil and hydroxylamine, prepared by the action of powdered sodium hydroxide on powdered hydroxylamine hydrochloride in pyridine suspension. It has now been found that if the hydroxylamine is prepared by the action of sodium bicarbonate on hydroxylamine hydrochloride in presence of a limited amount of water, continuing the preparation in pyridine solution by the method of Forster and Dunn, almost pure gamma benzilmonoxime is obtained, the crude material being identical with that obtained by Auwer's method (action of hydroxylamine hydrochloride on benzil dissolved in hot sixty per cent. ethyl alcohol). The crude material melts in each case at 102-104 degrees C. and mainly consists of an apparently monotropic modification of the gamma benzil monoxime, which can be isolated in a pure form from alcohol solution (m. pt. 106 degrees); on recrystallizing from benzene and heating to remove benzene present in the addition compound, the known gamma benzilmonoxime of m. pt. 112 degrees is obtained. This can be reconverted into the modification of lower melting-point by solution in alcohol.

Ethers of diethyl malonate and barbituric acid: **A. J. Hill and DeWitt T. Keach.** As an extension of previous work, the writers have shown that chloroethers of the general formula, $R\text{-}O\text{-}CH_2Cl$ ($R = CH_3$, C_2H_5, C_3H_7, C_4H_9, $C_6H_5CH_2$, etc.) may be utilized for the alkylation of diethylmalonate and its mono-alkylated derivatives, in particular, diethyl ethyl malonate. These new malonic esters combine smoothly with urea, in the presence of alcoholic sodium ethylate, giving ethers of barbituric acid. The investigations are primarily designed to establish new facts bearing on the relation between the chemical constitution of barbituric acid ethers and their physiological properties.

Condensation reactions of acetylene: **Harry Hoffman and J. A. Nieuland.** Formation of cyclic ethylidene ethers results when glycols are treated with varying parts of strong sulfuric acid not over twenty per cent., usually less than ten per cent., to which less than .01 per cent. of mercury sulfate is added as catalyst and dry pure acetylene gas is passed into the mixture. In this way a new compound, tetraethylethylidene ether (B.P. 95 degrees C.) is obtained, also trimethylene ethylidene ether, etc. The labile hydrogen in groups



$$\cdot\underset{\underset{O}{|}}{C}\cdot CH_2\cdot\underset{\underset{O}{|}}{C}\cdot$$

is also thus replaceable forming, *e.g.*, in case of malonic ester and acetylene, ethylidenemalonic ester, etc. Benzaldehyde and its homologues introduce acetylene with the formation of cinnamic aldehyde according to the reaction $C_6H_5CHO + CH \equiv CH + (\text{cat.}) = C_6H_5CH = CH\text{-}CHO$. The best synthetic yields hitherto obtained result from the process.

The constitution of coal tar: **John Morris Weiss and Charles Raymond Downs.** A description is given of an exhaustive analysis of coal tar based on the distillation in the plant of about 20,000 gallons of coal tar oil and its separation into very close fractions which we later examined in the laboratory. By this means analytical methods for the principal compounds in coal tar were developed. The paper does not give these analytical methods in detail but does give the results of the composition of an average sample of American coke oven tar, showing the proportions of the constitutions in the tar which exist in appreciable amounts.

On derivatives of the sulfur analog of choline: **R. R. Renshaw and N. Bekunowitz.** Several sulfonium compounds have been prepared including the acetyl formocholine analog. Their physical and chemical properties are being compared with corresponding derivatives of nitrogen and phosphorus, and attempts will be made to correlate these properties of the different compounds with their curare, nicotine and muscarine effects. Reid Hunt is making the pharmacological investigation of these substances. This work is being carried on with funds donated from the Bache Fund.

The constitution of N, N, 2, 2, 2, dichlorohydroxyethylidene-bis-nitroanilines: **A. S. Wheeler and S. C. Smith.** In a paper published by Wheeler in 1903 the constitution of these compounds was given as $(NO_2C_6H_4NH)_2CHCCl_2OH$. Since other compounds containing the grouping $\text{-}CCl_2OH$ are not known, these products were reexamined and constitutional studies now show that in the preparation of these compounds from the trichloro derivative by the action of alcoholic potash the OH group has wandered to the alpha carbon, the true arrangement therefore being $(NO_2C_6H_4NH)_2COHCCl_2H$. The proof is given in the reaction of the product with hot 80 per cent. sulfuric acid which splits the para compound into p-nitroaniline and p-nitrodichloroacetanilide, $NO_2C_6H_4NHCOCCl_2H$, which melts at 127 degrees and is identical with the product of the action of dichloroacetic acid upon p-nitroaniline in the presence of P_2O_5. The corresponding ortho compounds possess the same melting point, 70-72 degrees.

The problem of alternating polarity in chain compounds: J. B. Conant and W. R. Kirner. The relative reactivity of the chlorine atoms in two series of organic halides of the type ACH_2Cl, ACH_2CH_2Cl, $ACH_2CH_2CH_2Cl$, etc., has been studied by measuring the rate of the metathesis with KI in absolute acetone. The values obtained show that the position of the activating group (C_6H_5CO or C_6H_5) influence the reactivity of the halide in the following diminishing order: alpha > gamma > delta > beta. The gamma and delta positions were nearly equivalent in the one case studied (the C_6H_5 compound). These facts seem to indicate that there is no simple alteration is reactivity in chain compounds but that spatial effects are of primary importance.

The influence of certain gases on ferrous bicarbonate: Lawrence W. Bass and Oskar Baudisch. Our researches on the reduction of nitrates with ferrous hydroxide, on the splitting of pyrimidines with ferrous bicarbonate and on the aging of ferrous bicarbonate have not solved the question as to whether or not the action of these substances is due only to the nature of the surface of the freshly precipitated compound (absorption power). It is probable that another vital factor is the chemical nature of the various hydrates of the iron complex. To study the question further, an investigation was made of the activity of the ferrous bicarbonate when precipitated in the presence of various gases such as air, nitrogen, oxygen, nitrous oxide, acetylene and carbon monoxide. It has been proved that the activity of the compound is different, as shown by the quantity of thymine split, a fact which indicates that the second factor must be taken into consideration.

A new catalyst for use in catalytic oxidations in the vapor phase: Frederick William Atack. In the course of an investigation of the catalytic effect of certain porous materials, the activity was traced to the presence of titanic oxide. It is a matter of doubt whether this substance is as effective as the vanadic acid or molybdic acid catalyst, but it was found possible to oxidize naphthalene to phthalic acid and, more readily, anthracene to anthraquinone by passing the vapor mixed with air over the heated catalyst.

Fluoro and iodo-benzoyl-benzoic acids and their condensation to anthraquinone derivatives: F. C. Hahn and E. Emmet Reid. Fluorobenzene and o- and p-fluorotoluenes have been condensed with phthalic anhydride in presence of aluminum chloride, the resulting benzoyl-benzoic acids and their condensation to fluoro and methyl-fluoroanthraquinones studied. The fluorine derivatives correspond in constitution to the chloro compounds analogously obtained and resemble them in properties. The fluorine in p-fluoro-benzoyl-benzoic acid is replaced by hydroxyl on boiling with strong alkali. When iodobenzene is condensed with phthalic anhydride in the same way, most of the iodine is set free and the product is a mixture of benzoyl benzoic acid with about 12 per cent. of the p-iodo-benzoyl-benzoic acid which can be isolated by conversion to the iodoso chloride from which it is regenerated by reduction.

The reaction between benzyl bromide and alkyl magnesium bromides: H. T. Clarke, W. W. Hartman and M. R. Brethen. On adding benzyl bromide to an ethereal solution of butyl magnesium bromide, a vigorous reaction takes place, the main products being dibenzyl, alpha-butylene and butane. n-Amyl benzene is formed in only very small amount.

The preparation of acetylenes from dihalides: A. J. Hill and F. T. Tyson. It is well known that acetylenes of the normal type $R—C\equiv CH$, rearrange into more symmetrical configurations by the action of alcoholic potash, yet there appears to be a lack of information, from a quantitative standpoint, on the extent of molecular rearrangement when hydrogen halide is removed from symmetrical (1) and unsymmetrical (2) dihalides, either by solution methods, or in the gaseous phase with soda lime. (1) $R—CHX—CH_2X$. (2) $RCHX_2$. 1, 1 dichloroheptane, a representative of type 2, has been investigated with respect to the products resulting from gaseous phase dehalogenation with soda-lime in an electrically-heated tube. The results have thus far indicated that the tendency for molecular rearrangement is very pronounced, and even under the most favorable conditions the yield of the normal acetylene, $CH_3(CH_2)_4C\equiv CH$, is not above 30 per cent. calculated on the basis of the unsaturated compounds formed in the reaction, or 10 per cent., referred to the dichloroheptane.

Charles L. Parsons,
Secretary.

SCIENCE

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LIGHT WAVES IN ASTRONOMY[1]

When any object is viewed in a telescope the image formed at the focus results from the concurrence of the light waves which reach the focus from all parts of the object glass.

In the simplest case—that of a star which is so far away that it may be regarded as a point of light the image will not be a point, but a disc of appreciable size surrounded by a series of concentric circles as shown in Figure 1*a*.

In the case of a double star each component will present such a figure readily separable in a telescope of adequate size as in Figure 1*b*.

But if the stars form a very close double, the two figures overlap as in Figure 1*c* and in this case the system is not to be distinguished as a double.[2]

It can readily be shown that the limit of resolution is reached when the relation between the angular separative α_0 is given when this is equal to the ratio of the length λ of the light wave to the diameter d of the objective multiplied by the constant factor 1.22.

Thus in case of the 100-inch telescope at Mt. Wilson the angle would be $1.22 \times 1/50000$ x 1/100 or one in four million, corresponding to an angle of about one twentieth of a second of arc; which may be visualized as the appearance of a dime thirty miles away.

Next consider the appearance of an object presenting an actual disc such as a small planetoid. Each point of the disc would form an image like that in Figure 1*a*, the integrated effect corresponding to the appearance in Figure 1*d*.

Here again the appearance of d will not be distinguishable from Figure 1*a* if the angular diameter of the disc is less than $\alpha_0 = 1.22\lambda/d$. This then corresponds to the utmost attainable

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[1] Abstract of a lecture given under the auspices of the Carnegie Institution of Washington on April 26, 1923.

[2] At least not accurately measurable though there may be indications of doubling.

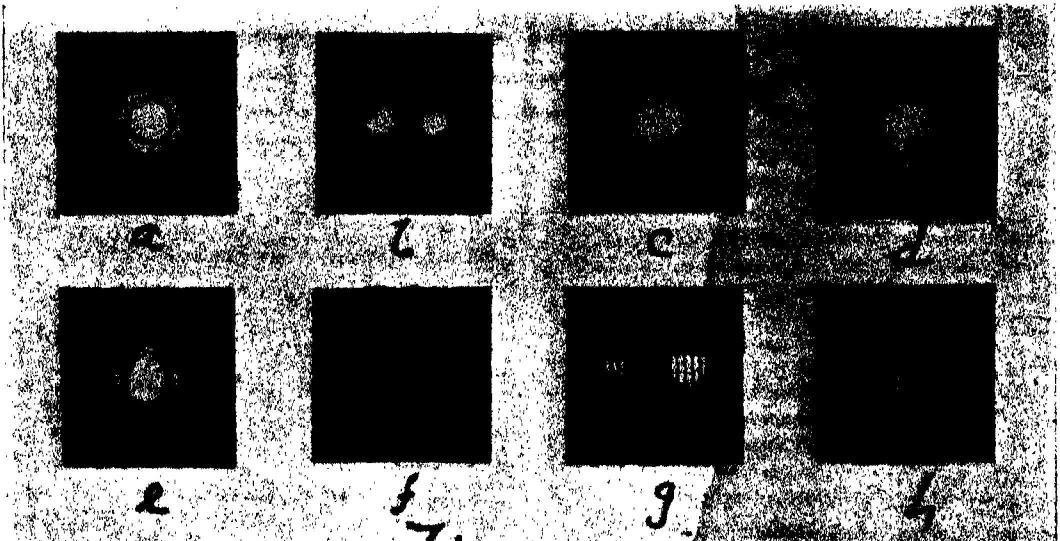

Fig 1

limit of resolution with the largest telescope in the world under perfect conditions of atmosphere.

But the character of the image at the focus (taking for simplicity the case of a star) depends on the form of the aperture of the telescope. If this were square instead of round the appearance would be that represented in Figure 1e.

If instead of a single aperture there are two arranged as in Figure 2 the appearance of the image of a star would be that shown in Figure 1f.

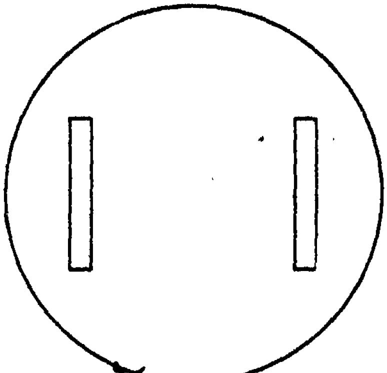

Fig. 2.

The figure presents no resemblance in this case to the object, but for purposes of measurement it has two important advantages. These may be best illustrated by considering once more the case of a double star, which would show a diffraction figure corresponding to Figure 1g if the two stars were well separated. If, however, the stars form a close doublet, these two figures will overlap[3] and at a definite distance will entirely vanish, if the two stars are equally bright. The graph representing the visibility of the fringes as a function of the distance between the two apertures is shown in Figure 3 corresponding to the formula $V = A\cos \pi\alpha/\alpha_0$ ($\alpha_0 = \lambda/d$). The vanishing of the fringes (which may be observed with remarkable accuracy) occurs at intervals corres-

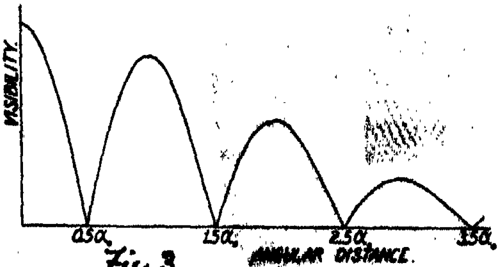

Fig. 3.

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[3] Fig. 1h represents the diffraction figure due to a very close doublet, the components of which are not in the same horizontal plane. If they were in the same plane, the fringes would vanish.

ponding to $\alpha = 1/2\alpha_0$, $3/2\alpha_0$, etc., or when

$$\alpha = \frac{\lambda}{2d}, \frac{3\lambda}{2d}, \text{etc.},$$

so that the resolution of a doublet by this method can be clearly established with a telescope of only four tenths the diameter of that required when using the full aperture.

But much more important is the fact that the vanishing of the fringes (or even the observation of the minimum in case the stars are of unequal brightness) is capable of far greater accuracy than the more or less vague observation of "resolution." Similar considerations show that the curve, Figure 4, representing the graph of the formula

$$\psi = \int_0^1 \sqrt{1 - w^2} \cos nw \, dw$$

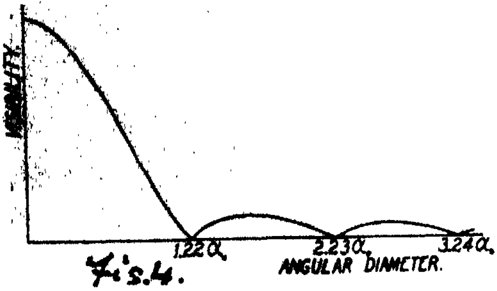

Fig. 4.

where $n = \pi d\alpha/\lambda$ give values $\alpha = 1.22\frac{\lambda}{d}$, $2.44\frac{\lambda}{d}$, etc., for the points at which the fringes vanish; whence α, the angular diameter of the disc, may be found—and with an order of accuracy but little inferior to that found in the measurement of the angular distance between the components of a double star.

A test, by the interference method, of the measurement of the diameter of the Satellites of Jupiter was made at Mt. Hamilton in 1890, giving results of considerably greater accuracy than any hitherto obtained, and proving clearly the applicability of the method to the measurement of discs of much smaller angular diameters than these. Thirty years afterward, by invitation of Dr. Geo. E. Hale, it was proposed to make an extended investigation into the possibilities of the method at the Mt. Wilson Observatory.

A preliminary trial with the forty-inch at the Yerkes Observatory showed clearly that interference fringes were readily observed even when atmospheric disturbances made "seeing" too poor for the usual astronomical observations. The same result[4] was obtained with the 60-inch and finally with the 100-inch at Mt. Wilson.[5]

The feasibility of the interference method being thoroughly confirmed, the problem of the investigation of the angular distance between the components of a double star was undertaken by Dr. J. A. Anderson.

From spectroscopic evidence Dr. W. W. Campbell showed that the star Capella was a binary star whose angular separation was just beyond the separating power of the 100-inch, so that it presented an object most suitable for the test.

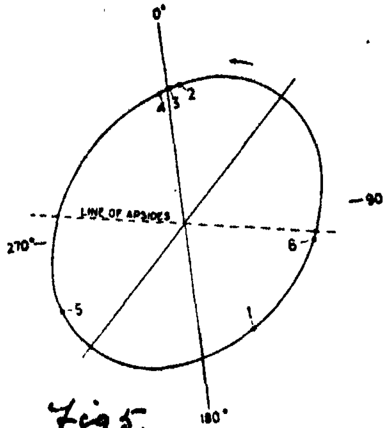

Fig 5.

The results of Dr. Anderson's work are shown in the graph, Figure 5, representing the orbit. The results of a comparison of the separate observations with the calculated orbit show that the accuracy of these measurements reach the extraordinary limit of one ten thousandth of a second of arc. (A dime at 30 miles distant would show corresponding irregularities of the order of a thousandth of an inch.) The stars are so far distant that, although many of them are much larger than our sun, the angular diameter of the disc they would present is too small for the largest telescope to discern. It would require a telescope two or three times as large as the 100-inch instrument at Mt. Wilson to render visible even the largest of these. The interferometer, however, offers a base line which may be much larger than the diameter of the telescope; and the previous work justified the hope that atmospheric disturbances would not seriously affect the clearness of the interference fringes.

---

[4] In this last test a diaphragm with two small apertures was placed near the focus, instead of at the objective, making measurement much more conveniently and without any loss of accuracy.

[5] A probable explanation of this unexpected result is doubtless something like the following:

When the entire aperture of the telescope is used, the integrated effect of the atmospheric disturbances is a confusion of the focal image generally referred to as "boiling." In the case of two small apertures at opposite ends of a diameter, the fringe system moves as a whole, but is nevertheless quite distinct so long as the motion is not too rapid for the eye to follow.

There was, however, considerable doubt as to the possibility of constructing so huge an instrument with sufficient rigidity to prevent warping or vibrations the amount of which must not exceed a ten thousandth of an inch. The work was undertaken at the laboratory of the Mt. Wilson Observatory under the direction of Mr. F. G. Pease.

A preliminary test showed the interference fringes quite clearly, even with rather poor "seeing."

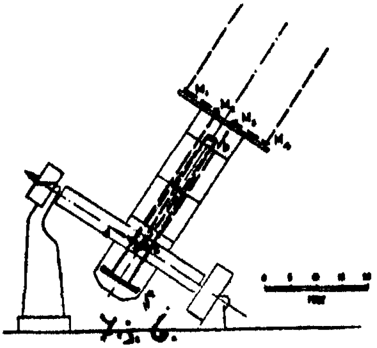

Fig. 6 gives a schematic view of the arrangement.

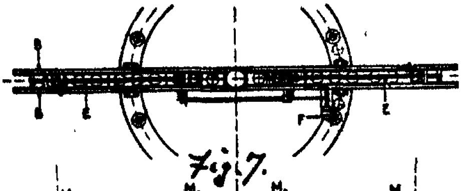

Fig. 7.

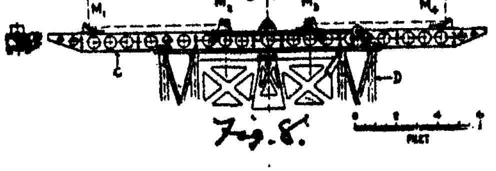

Fig. 8.

M, M_4 are two plane mirrors which reflect light from the star to the two mirrors M_2M_3, whence they proceed to the concave reflector M_5, proceeding thence ultimately to the focus of the instrument where they produce interference bands, which are viewed by an eyepiece at E.

Figure 7 shows the plan and Figure 8 the elevation of the interferometer beam and Figure 9 is a photograph of the beam attached to the tube of the telescope.[6]

Figure 9

On December 13, 1920, Mr. Pease reported:

"After preliminary settings on β Persei, with the mirrors separated 81 inches; and on β Persei and γ Orionis, with a separation of 121 inches (thus insuring that the instrument was in perfect adjustment), it was turned on α Orionis (Betelgeuse) and the interference fringes were sought for some time but could not be found. When next turned on α Canis Majoris the fringes at once appeared, thus furnishing a complete check."

The expression of the relation between α, the angular diameter of the star, and the distance δ between the mirrors at disappearance is $\alpha = 1.22\lambda/d$. Assuming the effective wave length $\lambda = 5750$ Angstrom units, and $d = 300$ c.m. the anguar diameter of Betelgeuse is 0".047. To find the actual diameter of the star we must multiply this by the distance of the star, which in terms of its parallax 0″.018 gives a result

---

[6] It was not at all necessary for optical requirements to use so large a telescope; but the 100-inch had such great stability that the additional weight (some 800 pounds) produced no derangement of its adjustments.

$$\frac{.047}{.018} \times 92{,}500{,}000,$$

that is a diameter of 240 million miles, 300 times the diameter of our sun!

This value is based, however, on the assumption that the disc presents a uniform illumination; but as there is undoubtedly a falling off of intensity away from the center this result may be considerably too small.

Since the announcement of this result several other stars have shown an appreciable diameter and one, Antares, is found to be even a bigger giant than Betelgeuse.

A still larger interferometer with a base of fifty feet is now under construction, by means of which the number of stars which fall within range will be considerably increased and it may even be hoped that the distribution of light over the discs may be determined.

A. A. MICHELSON

UNIVERSITY OF CHICAGO

TWENTY-SEVEN KINDS OF MEN

THERE are twenty-seven kinds of men. It is worth while to take account of personal stock and to honestly decide which of the twenty-seven varieties we ourselves represent, for it may be possible, within limits, to change ourselves, if desirable, into different sorts of men.

Or better yet, we might try to classify our neighbor whose faults, if not his virtues, are usually more apparent than our own. It is always an engaging mental exercise to size up other people since success in life depends largely upon correct judgments concerning those with whom we have to deal. In order to do this fairly we must discover what determines the sort of person our neighbor is and wherein he or she differs from twenty-six other kinds of people. There are three contributing factors that go to make up any man—or woman—and no one of the three can possibly be omitted.

The first is *environment* or the surroundings in which a person is brought up. It represents the opportunity or chance in life which one has. The second is *natural capacity* which is inherited from one's forbears. This is heredity or endowment. The third factor is the *response* which is made with a given inheritance, whatever it may be, within one's particular surroundings.

Environment is the stage setting; inheritance the actor and the response what the actor performs upon the stage. The play involves all three. Environment is what a man *has;* inheritance is what he *is* and response is what he *does.* It takes all three of these things to make a neighbor or any one else.

Furthermore, inheritance is decided beforehand for every man. No one can choose his parents or determine the inborn capacity with which they endow him. It is too late to do that when one arrives on the scene. If a man draws a blank in his biological inheritance he is simply out of luck for he cannot change it or draw again.

This is why there is no real reason for any one to be either proud or ashamed of his "blood," or his ancestry, whatever it may be. He has no hand in determining it. One may, however, properly feel pride or shame for the environment in which he remains or for the response that he makes with whatever ability he has to that environment, since both of these factors are to a degree within his control. When he marries he may also feel pride or shame in the mate whom he chooses to be the fellow determiner of the natural capacity which he wills to his children, because it is within his control thus to enrich or cheapen the blood that he has to pass on to the next generation.

To reduce the matter to the simplest terms, the three fateful factors that determine a man, namely, environment, heredity and response, may each occur in at least three varying grades indicated roughly as good, medium and poor. By combining these factors we arrive at twenty-seven kinds of men. For example, the inheritance that a man is born with may be good, medium or poor. Likewise the environment in which he finds himself and the response that he makes under the circumstances may be also good, medium or poor. In the list below are given the twenty-seven possible combinations resulting from this simple arrangement:

	Inheritance	*Environment*	*Response*
1.	Good	Good	Good
2.	Good	Good	Medium
3.	Good	Good	Poor
4.	Good	Medium	Good
5.	Good	Medium	Medium
6.	Good	Medium	Poor
7.	Good	Poor	Good
8.	Good	Poor	Medium
9.	Good	Poor	Poor
10.	Medium	Good	Good
11.	Medium	Good	Medium
12.	Medium	Good	Poor
13.	Medium	Medium	Good
14.	Medium	Medium	Medium
15.	Medium	Medium	Poor
16.	Medium	Poor	Good
17.	Medium	Poor	Medium
18.	Medium	Poor	Poor
19.	Poor	Good	Good
20.	Poor	Good	Medium
21.	Poor	Good	Poor
22.	Poor	Medium	Good
23.	Poor	Medium	Medium
24.	Poor	Medium	Poor
25.	Poor	Poor	Good
26.	Poor	Poor	Medium
27.	Poor	Poor	Poor

We are now ready to classify our neighbor. Which of the twenty-seven possible types does he represent and what hope is there of transforming him into a better man?

Take the case of a man like number fourteen in the list who is "medium" in all of the three determining particulars. How can he shift his position in the scale of life and become a different man?

In the first place he *can not change his heredity,* for, unlike the heir who inherits material property, he can neither lose nor add to his heritage of innate capacity, any more than a rabbit can lose or add to what makes it a rabbit and become a bird or some other animal. A man born medium in capacity must remain so.

He *can modify the environment* which holds him in its influential embrace and he *can* also *change his response* to that environment, either through education, experience and effort, or by the neglect of these means, so that the result will be a different kind of a man.

Moreover it is plain that in selecting a mate for our neighbor, which is always less complicated than selecting a mate for one's self, number nine in the list, that is, a person with good inheritance, poor environment and poor response, would be a better risk for him than number nineteen for instance, which denotes a person with poor inheritance, good environment and good response, not only because there would be more hope of improvment during the lifetime of the prospective partner but also because the possible children of such a union would start life with better "blood" or capacity and that is a priceless thing.

Too frequently what passes for a "good match" in society refers solely to environment and material possessions of the parties concerned rather than to their biological inheritance or blood. A man may marry a fortune and lose it but he can not lose his mother-in-law and all she means to the blood of his children. It is far better, indeed, to marry good blood than good environment because natural capacity usually leads, sooner or later, to an effective response which is likely in the end to insure a desirable environment. The self-made man who feels commendable pride in his handiwork is one who has risen in the ranks of the twenty-seven kinds of men but no one, even in a democracy, can go all the way from the bottom of the ladder to the top in one lifetime. That accomplishment takes generations of time and a judicious selection of one's grandparents.

H. E. Walter

Brown University

SCIENTIFIC EVENTS

THE ROCKEFELLER BUILDINGS AT UNIVERSITY COLLEGE, LONDON

A visit of the King and Queen of England to University College and its Medical School, London, to lay the foundation stones of the new obstetrical hospital and the new nurses' home was paid on May 31. According to the *British Medical Journal* these two buildings are in Huntley street, whose northern end is already occupied by one side of the medical school buildings which front the side of the hospital in University street. The King and Queen also formally opened the new Anatomy Institute of University College, recently erected in Gower street immediately south of the college quadrangle and west of the Physiological Institute, which also has been enlarged. It was announced nearly two years ago that the Rockefeller Foundation had arranged to give sums amounting together to £1,205,000 to University College and University College Medical School with the aim of forming in London an ideal medical school equipped in all departments on the most modern lines. Of the total amount given to the college the sum of £370,000 was for an Institute of Anatomy and for additions to the staff of that department and certain others. The cost of the site, building, equipment and library of the Institute of Anatomy was estimated to be £190,000, leaving a capital sum for maintenance of £180,000, calculated to provide £5,000 a year for additional staff in the anatomy department, £2,500 in the physiology department and £1,500 in other departments. University College Hospital fills an island site, so that it is not susceptible of enlargement. The number of beds at the disposal of the directors of the clinical units recently established was considered to be too small and it was not found possible to make proper provision for obstetrics. It was decided, therefore, to take over the space in the nurses' wing and to build a new nurses' home and a new obstetrical hospital. The Rockefeller Foundation arranged to give £400,000 to University College Hospital and Medical School for building and reconstruction and £435,000 for maintenance. The income of this endowment fund is to be used for the furtherance of medical education and research in the Medical School, but a sum not exceeding £16,000 a year is to be applied to the upkeep of the 120 beds allocated to the purposes of the medical and surgical units until such time as money can be otherwise raised, when the income of the endowment will be restored to its original purpose of helping medical education and research. The new buildings for the obstetrical department, it is estimated, will cost £110,000 and will provide sixty beds; the responsibility for their maintenance will fall on the corporation of the hospital, which will have to increase its present income by some £15,000 to £20,000 a year.

"UNIVERSITY CITY" AT PARIS

THE Paris correspondent of the *Journal* of the American Medical Association reports that the corner stone of the "University City" was laid on May 9 in the presence of M. Léon Bérard, minister of public instruction; M. Paul Strauss, minister of public health; Professor Paul Appell, rector of the University of Paris; the deans of all the faculties of the University of Paris; Dr. de Lobinière-Harwood, dean of the Faculty of Medicine of Montreal; Dr. Rousseau, dean of the Faculty of Medicine of Quebec, and many other university professors. The men and the women students were represented by the respective presidents of the general associations. A student, M. Kauck, read an account of the origin of the University City, which had been engrossed on parchment and which was afterward enclosed in the corner stone of the edifice, together with a number of coins of this year's mintage, to perpetuate the memory of the establishment.

This is the first of a group of buildings intended to provide healthy and economical lodgings for 350 men and women students of limited means. They are to be erected on the leveled fortifications of Paris, at the southern extremity of the Latin Quarter, on a plot of ground deeded by the city to the University of Paris. The funds for the buildings themselves were secured through the liberality of M. Emile Deutsch de la Meurthe, who made for this purpose a gift of ten million francs. The hope is entertained that the foundation established by M. Deutsch de la Meurthe will be followed by others, all destined to provide for the needs of students and due to the initiative of generous minded persons, whether they be French or foreigners, who are friends of France. This group of buildings will form the University City, so called, and will constitute a suburb for students situated between the Montsouris Park and another park to be especially laid out for them through the solicitude of the city of Paris. As is impressively stated in the parchment roll deposited in the corner stone, "Thus will have been established a new focus of French and human culture, where three thousand students, coming from all countries of the world, provided with books, sunlight and fresh air, brought together in affectionate emulation and reflecting honor on the oldest university of Europe (founded in the second half of the twelfth century), will work together in concert to bring about a harmonious development of their minds and bodies, which will redound to the progress of science and to an understanding among the nations they represent."

AWARDS OF THE ROYAL GEOGRAPHICAL SOCIETY

LORD RONALDSHAY made the presidential address at the anniversary general meeting of the Royal Geographical Society on May 28. At its conclusion he presented the medals and announced the other awards for the year:

The Founders' Medal—the highest recognition of the society—he said, was awarded this year to a distinguished Danish explorer, Mr. Knud Rasmussen, for his scientific exploration of Greenland and the American Archipelago, which he had been carrying on with unabated zeal and with marked success over a period of more than twenty years. The son of a Danish missionary in North Greenland, Mr. Rasmussen included amongst his achievements the famous journey in 1912 across the inland ice of North-West Greenland to the opposite coast and back, one result of which was to show that Peary Land was a part of the mainland, the supposed Peary Channel being a fjord only. A further journey, planned in 1916 and undertaken in 1917, with an investigation of possible Eskimo migrations by the extreme north of Greenland as one of its objects, produced no trace of any such migration. This negative result, however, was accompanied by positive results of value in the spheres of botany, zoology and geology, thanks to the labors of his companions, Wulff and Koch, while all the great fjords along the north of the coast of Greenland were mapped. The expedition was carried out amid great difficulties and hardships. Since 1921 Mr. Rasmussen had embarked upon a prolonged expedition of the American Arctic Archipelago with a view to carrying out a systematic ethnological investigation of those regions—a project which he had evolved some eleven years before. The expedition was still in the field and was not expected to return before next year.

The society's other gold medal was awarded to the Hon. Miles Staniforth Smith for what the president described as a remarkable journey into the interior of Papua made in 1912, when Mr. Smith was administrator of that territory. It was, he said, especially fitting that the exploration of the inaccessible hinterland should have been carried through by an eminent citizen of the Australian Commonwealth.

The other awards were: The Gill Memorial.—To Captain Augiéras, who has traveled extensively in North-West Africa since 1913, with a view to lifting the veil from the little-known stretches of the Sahara.

The Murchison Grant.—To Captain A. G. Stigand, who had a long period of government service in Africa. In 1910 he became a resident magistrate for Nagamiland, and the particular piece of work which had earned for him the award was an admirable map of that country.

The Cuthbert Peek Grant.—To Mr. Frazer and Mr. Odell, the surveyor and the geologist of the Oxford expedition to Spitsbergen in 1921.

The Back Grant.—To Mr. B. Glanvill Corney, writer on geographical subjects and editor of four of the volumes of the Hakluyt Society.

AN OUT-OF-DOORS MUSEUM FOR THE UNIVERSITY OF MICHIGAN

AN anonymous donor has purchased for the University Museums, University of Michigan, a tract of land comprising 120 acres in Missaukee County, Michigan, for museum purposes. To this area has been added, by deed from the Department of Conservation to the university, 240 acres of tax homestead lands in two parcels, one of eighty acres and another of 160 acres. The eighty acres adjoins the original 120 acres, making a tract of 200 acres, which is close to the 160 acres. It is expected that the two tracts can easily be united in the future if this is considered advisable.

The whole tract has been deforested, but not cleared of the second growth and it is the site of many remarkable Indian earthworks, including two large circles, many Indian mounds and hundreds of pits. The principal purpose of the gift is to preserve the Indian remains and to make possible their detailed study by the Museum of Anthropology. The area is also to serve as a sanctuary for native animals and plants and as a place where experimental field studies may be carried on by the Museum of Zoology.

The earthworks will be restored after exploration and roads will be opened to the more conspicuous ones, so that tourists may inspect them under proper restrictions. In other words, the preserve will be an out-of-doors museum in the broadest meaning of the term museum, since it will preserve and exhibit the Indian remains and wild life and at the same time provide facilities for research.

ALEXANDER G. RUTHVEN

SCIENTIFIC NOTES AND NEWS

For the Roosevelt Memorial Association, President Harding presented on June 15 gold medals to Miss Louisa Schuyler, known for her philanthropic work; Professor Henry Fairfield Osborn, president of the American Museum of Natural History, and Major General Leonard Wood. In presenting Professor Osborn, Mr. Hagedorn said that Theodore Roosevelt had sought him out again and again "as the highest authority in a field that was dear to his heart."

A portrait of Professor A. A. Michelson, for over thirty years head of the department of physics in the University of Chicago, which was painted by Ralph Clarkson of Chicago, is to be a gift to the university from a large number of Professor Michelson's former students and friends. The portrait has been temporarily placed in the Quadrangle Club.

The University of Cambridge will confer the degree of Doctor of Science on Wilder Dwight Bancroft, professor of chemistry in Cornell University; Ernst Julius Cohen, professor of chemistry in the University of Utrecht; Albin Haller, president of the Academy of Sciences of the Institute of France; Charles Moureu, professor of chemistry in the Collège de France; Raffaelo Naisni, professor of chemistry in the University of Pisa; Amé Pictet, professor of chemistry in the University of Geneva; and Frédéric Swarts, professor of chemistry in the University of Ghent.

The University of Oxford will confer at the forthcoming commemoration on June 27 the honorary degree of doctor of science on Sir E. Rutherford, F. R. S., Fellow of Trinity College and Cavendish professor of experimental physics in the University of Cambridge, and on Dr. Louis Lapicque, professor of physiology in the University of Paris.

The British Institution of Electrical Engineers has presented its Faraday medal for "notable scientific or industrial achievement in electrical engineering, or for conspicuous services rendered to the advancement of electrical science," to Sir Charles Parsons, the distinguished engineer.

The David Livingstone Centenary Medal for 1923 has been awarded to Griffith Taylor, associate professor of geography in the University of Sydney, Australia. This medal, founded by the Hispanic Society of America and awarded by the American Geographical Society, is given "for scientific achievement in the field of geography of the southern hemisphere." The second Pan-Pacific Scientific Congress will meet in August and September of this year in Australia at which time presentation of the medal to Dr. Taylor will be made by the American Geographical Society's representative.

The honorary degree of doctor of science was on May 31 conferred on Dr. Karl F. Kellerman, associate chief of the Bureau of Plant Industry of the Department of Agriculture, by the Kansas State Agricultural College. Dr. Kellerman is the son of William A. Kellerman, professor of botany in the college from 1883 to 1891.

Professor Warren G. Waterman has been elected president of the Illinois State Academy of Science for 1923-24.

Professor D. M. Mottier, of the University of Indiana, has been appointed chairman of a committee for the state for the conservation of rare wild species of ferns and flowering plants.

The Sigma Xi fellowship for the year 1923-24, with a stipend of $1,500 and $500 for expenses, has been granted to Professor Roy L. Moodie, of the College of Medicine, University of Illinois, Chicago. Professor Moodie expects to continue his studies in paleontology, working in various museums in California and the southwest.

The Ricketts Prize of the University of Chicago for research in pathology, hygiene and bacteriology for 1923 is divided between Lauretta Bender and Robb Spalding Spray. Miss Bender receives a first prize of $300 for "Hematological studies in experimental tuberculosis of the guinea pig," and Mr. Spray a second prize of $50 for "A bacteriological study of pneumonias of sheep."

Dr. R. B. Moore, retiring chief chemist of the Bureau of Mines, was guest of honor at a luncheon on May 29, which was attended by a large number of his associates at the bureau.

Walter M. Berry, who has been chief of the gas engineering section of the Bureau of Standards, has resigned effective July 1 to become engineer in charge of research of the California Gas Research Council.

A. H. **Hooker**, of the Hooker Electrochemical Company, was elected president of the Manufacturing Chemists' Association at the annual meeting held in New York on June 5.

Dr. Victor F. Hess, chief physicist of the United States Radium Corporation, has resigned to assume the chair of experimental physics at the University of Graz in Austria.

Professor Colin G. Fink, head of the division of electro-chemistry, Columbia University, has been elected to honorary membership in the honorary engineering fraternity Tau Beta Pi. Dr. Fink has recently been granted letters patent on his insoluble cupro-silicon anode now in successful operation at the large copper works at Chuquicamata, Chile.

Eric A. Lof, who since 1909 has been connected with the power and mining engineering department of the General Electric Company as industrial engineer and specialist, has resigned to take up work with the American Cyanamid Company.

The representatives of the American Association for the Advancement of Science at the twenty-sixth annual meeting of the American Society for Testing Materials, to be held at Atlantic City, New Jersey, from June 25 to 29, are: George K. Burgess, director of the United States Bureau of Standards, and C. L. Warwick, secretary-treasurer of the society. At the exercises held during commencement week at the Carnegie Institute of Technology, Pittsburgh, Pennsylvania, the association is to be represented by Edward K. Strong, Jr., professor of education and head of the department of educational reference and research in the institute.

Officers of the Linnean Society, London, have been elected as follows: *President,* Dr. A. B. Rendle; *treasurer,* Mr. H. W. Monckton; *secretaries,* Dr. B. Daydon Jackson, Dr. W. T. Calman and Captain J. Ramsbottom; *other members of council,* Dr. W. Bateson, Dr. G. P. Bidder, Mr. R. H. Burne; Professor F. E. Fritch, Professor E. S. Goodrich, Dame Helen Gwynne-Vaughan, Sir Sidney F. Harmer, Dr. A. W. Hill, Mr. L. V. Lester-Garland, Baron Rothschild, Dr. E. J. Salisbury, Mr. R. J. Tabor, Mr. T. A. Sprague, Professor F. E. Weiss and Dr. A. Smith Woodward.

Dr. W. J. Mayo, of the Mayo Clinic, Rochester, Minnesota, who had conferred on him the honorary doctorate of laws at the recent commencement of McGill University, has sailed for Europe where the degree of master of surgery will be conferred on him by Trinity College, the University of Dublin and the degree of doctor of science by the University of Leeds. Dr. Mayo will present a paper on July 17 before the International Surgical Congress.

Dr. Hugh S. Cumming, surgeon general of the United States Public Health Service, has been attending meetings of the committee on health of the League of Nations held in Paris at the end of May.

A **scientific** mission, composed of Professor Moureu, chemist at the Collège de France, his son and an assistant, has left Marseilles for Madagascar to examine the radio-active deposits which have been discovered on the island and to ascertain the properties of the thermal waters at Antsirabe.

Dr. Arthur D. Little, of Cambridge, spoke on June 13 before the New York State Bankers' Association on "The chemistry behind the dollar."

Dr. W. D. Bancroft, professor of physical chemistry in Cornell University, gave an address entitled "A plea for research" at the house of the Royal Photographic Society, London, on June 5.

Professor H. R. Kruyt, who occupies the chair of physical chemistry in the University of Utrecht, recently gave a lecture upon the electric charge of colloids before the medical chemistry department of the University of Edinburgh.

Mr. J. T. Saunders, demonstrator of animal morphology at the University of Cambridge, is giving at Basle a course of twelve lectures on the "Basis of fresh water biology" in the university. Mr. Saunders is lecturing in French. These lectures are a return for those delivered by Professor Zschokke, of Basle University, last term in Cambridge on the "European fauna."

PROFESSOR E. W. D. HOLWAY, of the University of Minnesota, died at Phoenix, Arizona, on March 31, aged seventy years. He had recently returned from Brazil with large collections of fungi and flowering plants.

DR. A. LOOSS, formerly professor of parasitology in the School of Medicine, Cairo, died on May 4, aged sixty-two years.

MR. M. DE C. S. SALTER, superintendent of the British Rainfall Organization, died on May 21, aged forty-two years.

CAPTAIN CARL HARTVIG RYDER, director of the Danish Meteorological Service, died on May 3.

COLONEL GEORGE FALCONER PEARSON, distinguished for his work on forestry in India, died on April 25, at Kington, Herefordshire, aged ninety-six years.

ON June 7, at the Brooklyn Botanical Garden, was unveiled the Alfred T. White Memorial. This consists of a semi-circular seat of stone facing a tablet of serpentine rock bearing a bronze bas-relief six feet high by five and one half feet wide, by Mr. Daniel Chester French. At the right of the design is the figure of a woman, seated, with a small child beside her. In her lap is a partly completed wreath of mountain laurel, and she is reaching forward to pluck a branch from a laurel bush in blossom on the opposite side of the plaque beneath an oak. The seat and tablet were designed by Mr. Henry Bacon, who was the architect of the Lincoln monument in Washington. The memorial was a gift from former associates and friends of Mr. White.

WE learn from *Nature* that at the annual meeting of the Institution of Electrical Engineers May 31, there was presented to the institution: (1) an oil painting of the late Dr. Silvanus Thompson (presented by Mrs. Thompson); Dr. Thompson's library (presented by a number of members of the institution and others); and (2) a bronze bust of Dr. Thompson, by Mr. Gilbert Bayes (presented by the Finsbury Technical College Old Students' Association).

A PRELIMINARY announcement regarding the general discussion on the electronic theory of valency arranged by the Faraday Society, to be held at Cambridge on July 13-14, has been issued and is summarised in *Nature*. Professor G. N. Lewis, of the University of California, will open the proceedings on the Friday afternoon with a general introductory address and he will probably be followed by Mr. R. H. Fowler, with a paper intended to open discussion on the physical and inorganic side of the subject. Among those expected to speak are Sir J. J. Thomson, who will be in the chair; Sir Ernest Rutherford, Sir William Bragg and Professor W. L. Bragg. The Saturday morning session will be devoted chiefly to applications of the theory in organic chemistry. Sir Robert Robertson, president of the society, will preside, and opening papers will be given by Professor T. M. Lowry and Dr. N. V. Sidgwick. Among those expected to speak are Professor W. A. Noyes, Sir William Pope, Professor A. Lapworth, Professor I. M. Heilbron, Dr. W. H. Mills, Professor J. F. Thorpe and Professor R. Robinson. On the Friday evening a complimentary dinner will be given to Professors Lewis and Noyes and other guests at Trinity Hall.

DR. FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, is visiting research institutions and particularly physiological laboratories in the principal countries of Europe. An address on the work of the Carnegie Institution of Washington in general and the Nutrition Laboratory in particular was given by Dr. Benedict in the new amphitheater of the Société Scientifique d'Hygiène Alimentaire in Paris on April 14. At a joint meeting of the Biochemical and Medical Societies of Berne, on April 30, a lecture on the recent work of the Nutrition Laboratory on basal metabolism and insensible perspiration was given. An address on the simple method of determining the gaseous metabolism in man, recently devised by Dr. Benedict and Mrs. Cornelia Golay Benedict, was delivered on May 14 at Heidelberg, before the Naturhistorisch-medicinischer Verein, together with a discussion of normal basal metabolism. In Halle on May 16 an address was given before the faculty and students of the medical department of the university on the determination and significance of basal metabolism in clinical medicine. After visiting Berlin, Sweden, Finland, Denmark, Holland, Belgium and

England, Dr. and Mrs. Benedict will attend the International Congress of Physiology at Edinburgh, returning to Boston in August.

The station budget for the year 1923-24 of the New York Agricultural Experiment Station at Geneva, New York, carries a total of $250,035, an increase over that for the past year of $31,585. Of this sum, $16,800 is specifically appropriated for special research in horticulture in the Hudson River Valley. No permanent sub-station is to be established, only temporary field laboratories wherever the problems demand close attention. The work will be under the direction of the station at Geneva and three new positions on the station staff have been created to take care of the new lines of work. These positions will include associates in research in entomology, horticulture and plant diseases. These appointments will take effect July 1 next. Three new positions have also been created on the staff at Geneva, beginning with July 1. Two of these will be assistants in research in dairying and one a laboratory technician. Provision is made for the publication of "The small fruits of New York," the next in the series of fruit books published by this station. Work is already under way on this book. The bill providing for the administration of the Geneva station by the trustees of Cornell University has been signed by the governor and will take effect July 1. The present board of control will be abolished and the station will be administered by Cornell University, but with a director and staff as heretofore.

The Mexican government is making special arrangements for the several scientific expeditions expected to visit Mexico to make observations of the total eclipse of the sun next September. Camille Flammarion, director of the Paris Observatory, has notified the Mexican government that he will head an expedition which probably will establish headquarters in Durango. Dr. Albert Einstein may go to Mexico to observe the eclipse. Among Americans who will visit Mexico are Dr. John Miller of Sproul Observatory, Swarthmore, Pennsylvania, and Dr. Douglas of the University of Arizona. The eclipse will have a path of about 105 miles, passing from the islands off the coast of California through Sonora to Durango. Dr. Douglas expects to establish his expedition in Lower California. The northern limit of totality will lie one mile to the northeast of Santa Barbara.

Announcement of personnel and plans of the committee which is to direct a national investigation of the storage of coal in cooperation with the United States Coal Commission, the Department of Commerce and the Bureau of Mines is made by the Federated American Engineering Societies. The committee members are: H. Foster Bain, director of the United States Bureau of Mines, Washington; David Moffat Myers, former fuel administrator, New York; Perley F. Walker, dean of engineering, University of Kansas; W. H. Hoyt, chief engineer of the Duluth, Missabe and Northern Railway, Duluth, Minn.; S. W. Parr, professor of applied chemistry, University of Illinois; Edgar S. Nethercut, secretary of the Western Society of Engineers, Chicago; Roy V. Wright, editor, New York. The chairman is W. L. Abbott, chief operating engineer of the Commonwealth Edison Company of Chicago. This main committee, it was stated by Dean Mortimer E. Cooley, of the University of Michigan, president of the Federated American Engineering Societies, will work with committees in every state, studying local conditions through local engineers in an effort to find a solution for the problems of coal consumers from the small households to the largest industries. Thirty national and local engineering societies, members of the federation, have been enlisted in the work and will be aided by other engineering groups, state administrative committees, federal and state agencies, private enterprises, civic bodies, corporations and individuals. The investigation, the first of its kind to be undertaken in this country, will deal with the whole range of problems affecting the storage of coal.

The Tortugas Laboratory of the Carnegie Institution of Washington will be open for two or three months during the present summer in order that investigators who have formerly undertaken researches in association with the department of marine biology of the institution may be afforded an opportunity to continue such investigations with a view to the completion of their studies for purpose of publication. It is expected that Dr. Paul Bartsch, of the

United States National Museum; Dr. W. H. Longley, of Goucher College, and Dr. A. A. Schaeffer, of the University of Tennessee, will pursue investigations at Tortugas in accordance with this plan. The equipment of the laboratory will be in charge of Mr. John W. Mills, engineer of the Department of Marine Biology.

THE second annual session of the Rocky Mountain Biological Station began on June 11 and continues until August 24. The second half begins on July 19. The station is located at Gunnison, Colorado, close to the continental divide and is conducted as a part of the Western State College of Colorado. The staff for 1923 is: Dr. John C. Johnson, of Western State College, director; Dr. J. D. McDonald, of California State College; Mr. J. P. Eskridge, formerly of Silliman Institute, Philippines; Mr. C. R. Walker, of Western State College; Mr. C. T. Hurst and Miss Virginia McCleary, assistants; Dr. Charles A. Kofoid, of the Universiy of California, special lecturer, July 23-27. The greatest emphasis will be placed upon parasitology and animal and plant ecology, although the standard courses in botany and zoology will also be given.

THE National Association of Manufacturers of Carbonated Beverages has established at the Iowa State College a fellowship in food and sanitary chemistry which will carry a stipend of from $2,000 to $2,500 for the next two years. Professor Buchanan, in charge of food and sanitary chemistry, will direct the work.

THE Hammermill Paper Company, through their chemical director, Dr. Bjarne Johnson, has offered to the trustees of the New York State College of Forestry a fellowship for the coming year of the value of $1,200 to be known as the "Hammermill fellowship in pulp and paper manufacturing." The fellowship has been awarded to Mr. Burton L. Kassing, of Utica, New York.

MESSRS. NORTON AND GREGORY, Limited, London, manufacturers of drawing and mathematical instruments, etc., are offering two engineering scholarships to be competed for annually, one value £100 per annum and one value £50 per annum, tenable for three years at any university in the United Kingdom or British Dominions approved by the honorary committee, of which Sir Joseph Petavel, F.R.S., director of the National Physical Laboratory, Teddington, is the chairman. The object is to assist those who are unable to take up a complete course of engineering at a university owing to lack of the necessary funds.

GOVERNOR Cox has signed a bill to authorize the trustees of Northeastern University of the Boston Young Men's Christian Association, "to confer such degrees as are usually conferred by colleges and universities in this commonwealth, except medical and dental degrees and degrees of bachelor of science and bachelor of arts, and to grant diplomas therefor."

Nature writes: "Scientific workers are too well acquainted with the value placed on their services to be surprised at an advertisement for a university assistant lecturer in a department of science at a salary of £300 a year. Recently, however, such an offer provoked an indignant protest from a disinterested member of the general public, who stated to us that the remuneration of his chauffeur was on a more liberal scale. While it is true that any educated man with aspirations would prefer a university teaching post, with its vague promise of an interesting and useful career, to the more mundane occupation, it is nevertheless a matter of the gravest concern that those educational institutions which are engaged in the task of increasing and disseminating knowledge are in such a parlous financial position that they are forced to offer salaries bearing no relation to the status of the posts, and imposing on their holders an unfair burden of financial sacrifice. The greatest benefactors of the universities are still the members of the teaching staffs themselves."

THE British Colonial Office has announced that the vessel *Discovery* has been purchased by the Crown agents for the colonies on behalf of the government of the Falkland Islands, to be employed principally in research into whaling in South Georgia and the South Shetlands. The London *Times* notes that there is a very large whaling industry in these dependencies and knowledge in regard to the numbers and habits of the whales is insufficient to enable the industry to be controlled in such a way as to afford security against depletion of the stock. The principal task for which the *Discovery* will be employed is to ascertain the geographical limits of the whales, to trace their migrations and to form some idea of their numbers and the rate of reproduction. But the expedition will also afford opportunities for adding to scientific knowledge in many other directions and particularly in oceanography, meteorology and magnetism. As the *Discovery* will require extensive reconstruction, it is not anticipated that she will be ready to sail before next year. The enterprise will be carried out under the instructions of the Colonial Office, and the Duke of Devonshire is taking steps for the appointment of an executive committee to undertake the management. It is proposed that the Colonial Office, the Admiralty, the Ministry of Agriculture and Fisheries, the British Museum (Natural History) and the Royal Geographical Society should be represented upon the executive committee. The committee will keep in close touch with other institutions and individuals who are interested in Antarctic research. The *Discovery*, a strong wooden ship of about 700 tons register, was built at Dundee for Captain R. F. Scott's expedition to the Antarctic, which started in 1901. The ship was frozen in at its winter quarters and Scott received orders to abandon her and return in the relief ships sent, but the *Discovery* broke out of the ice in February, 1904, and Scott brought her home in perfect order.

The governments of South Africa, Australia, the Argentine Republic and possibly the United States will cooperate with Great Britain in an Antarctic expedition, preliminaries of which are being discussed. In all probability plans will be completed in London.

UNIVERSITY AND EDUCATIONAL NOTES

Announcement was made at commencement at Lafayette College, by President John H. MacCracken, of the gift of $200,000 by Mr. John D. Larkin, of Buffalo, to endow "The John D. and Frances H. Larkin professorship of chemistry." In accordance with the conditions of the trust, four fifths of the income is subject to an annuity for one life, the other one fifth of the income will be immediately available for the work in chemistry.

The Michigan College of Mines has received a gift of $10,000 from Dr. Edgar Kidwell, head of the Kidwell Boiler Company, of Milwaukee, for the founding of a scholarship in memory of his son, who was killed in the war. Dr. Kidwell was formerly professor of engineering in the college.

Dr. Edgar Fahs Smith, formerly provost of the University of Pennsylvania, laid the cornerstone of the new chemical laboratory of the Rice Institute, Houston, on June 4. The laboratory, which will be erected at an approximate cost of $1,000,000, will be ready in September, 1924.

Proposals for the removal of Randolph-Macon College to Norfolk and for its consolidation with American University at Washington have been rejected by the board of trustees, following a meeting attended by members of the faculty and alumni of the institution.

John H. Mueller, Ph.D., associate professor at the College of Physicians and Surgeons, Columbia University, has been appointed assistant professor of bacteriology at the Medical School of Harvard University.

Dr. Leslie A. Kenoyer, assistant professor of botany in the Michigan Agricultural College, has been chosen professor of biology at the Western State Normal School, Kalamazoo, Michigan.

Mr. J. T. Saunders, senior fellow of Christ's College, Cambridge, and demonstrator of animal morphology, has been elected tutor of Christ's College, in succession to Dr. F. H. A. Marshall, F. R. S., who has resigned.

DISCUSSION AND CORRESPONDENCE

NOTE ON PREPARING COLOR STANDARDS

When it is desirable to develop a colorimetric method for measurement of the small amounts of substances met with in biological studies the worker must frequently devise his own color standards. After a color has been matched to that produced by the substance to be detected a colorimeter may often be employed for the determinations. But when a colorimeter is prohibitive, a series of tubes ranging by the smallest perceptible variations in color may prove satisfactory.

One difficulty in preparing a set of tubes in this fashion lies in the fact that to the unaided eye a change in color is less noticeable between deep colors than the same change between diluted ones. This is apparently a geometric relationship, as demonstrated in an article[1] recently published by the author.

This finding is not at variance with that of Lovibond.[2] But it is not necessary to have recourse to a "specific color factor" for practical purposes, as it is only essential to dilute the colored solution sufficiently to ascertain roughly the number of tubes required for a geometric series that will fulfill the requirements at hand.

Having a colored solution that matches the heaviest shade of the substance to be estimated, we dilute an aliquot with an equal volume of water, part of this we dilute again, etc., till there is but a perceptible difference in shade between our last two dilutions. We can then calculate the number of tubes required for the series and may ascertain the factor for the set, using the formula

$$r = \sqrt[n-1]{\frac{1}{a}}$$

Of course, the number of tubes required to complete a series graded by the nearest perceptible change in color will vary as the intensity of the terminal solution and in the case of a very weak solution many less tubes will be necessary than in a strong one. Then, too, if the grading is through a definite number of tubes rather than by intensity of color and the tubes are too few in number, these large jumps in color by reason of their geometric relationship may give rise to errors when interpolating, especially in the deep colors. The size of the factor rests somewhat on the degree of accuracy desired in reading between tubes.

It is suggested that color standards may be more easily and reliably prepared in the manner outlined above than by matching or diluting by the unaided eye.

ARTHUR P. HARRISON

BUREAU OF PLANT INDUSTRY

A FACTOR CAUSING THE ASSIMILATION OF CALCIUM

IN the work of Dr. Forbes, formerly of this station and the earlier work of Hart and his associates and of Meigs and his associates it has been demonstrated that milking cows receiving a ration of grain and dry hay, with and without mineral supplements, are brought into a decided negative calcium balance. Hart has also shown that goats, after a period of negative calcium balance, have been able to produce a positive calcium balance when placed on green feed. He states that apparently there is something having its source in fresh green material which controls or assists calcium assimilation.

Working on the hypothesis that most of the calcium, in whatever combination it may be, in the cells of green plants is in a highly dispersed form and hence better assimilated than the calcium in the dry plant, the drying of which no doubt causes a change in the physical properties of the cell and its content, we set about to imitate, in a rough way, the cell content as far as it represents our idea of the highly dispersed form in which the calcium exists in green plants. A starch paste was made up with a known solution of $CaCl_2$ (2 Molar). Then an equal volume of Na_3Po_4 of the same strength as the $CaCl_2$ was added. The starch acted in a slight degree as a protective colloid for the calcium ion and the final product, $Ca_3\ (Po_4)$ was left in a highly dispersed form. This starch paste was added to the ration of grain and dry timothy hay, which in turn was fed to two milking goats.

The goats were mature animals in their third and fifth months of lactation and weighed 30 and 40 kilograms respectively.

This test was carried on for a period of 26 days preceded by a preliminary period of 10 days. The 26 day period was divided into three periods of 7, 7 and 12 days respectively. The calcium intake was from 5 to 6 grams per day. Out of the six complete accountings of the calcium five were positive, the sixth showing a negative balance of 0.32 grams calcium for the 12 days. This was a little surprising to us after we had failed, in a previous trial, to obtain a positive calcium balance on a dry ration and a mineral supplement. We realize that the goats were in a later stage of lactation in this trial than in the one two months previous, when a negative calcium balance was obtained, with practically the same intake, yet we do not believe that this difference can be entirely attributed to this factor.

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[1] "Geometric progression in optically prepared standards," *J. Amer. Op. Soc.*, May, 1923.

[2] Lovibond, J. W., "Light and color theories," 1915, Appendix II, p. 77.

A vitamin or the vitamins of green plants may play an important part in the assimilation of calcium, yet we do believe the difference between green (fresh) and dry plants in causing the assimilation of calcium is partly due to the difference in physical properties of the cell wall and the cell content.

Our data are not yet inclusive enough to substantiate our hypothesis or to draw definite conclusions.

Chas. H. Hunt,
A. R. Winter
Ohio Agricultural Experiment Station,
Wooster

TRABECULAE OF SANIO IN ANGIOSPERMS

The occurrence of "Trabeculæ of Sanio" has been noted previously only in Gymnosperms but their discovery in an Angiosperm at the Forest Products Laboratories of Canada demonstrates a wider distribution than hitherto has been credited to these rod-like structures which extend across the lumina of cells.

Typical trabeculæ—homologues of those common to Gymnosperms—were observed extending radially throughout a series of tracheids in secondary wood from the stem of *Alnus oregona,* Nutt. One section of this alder shows a series of trabeculæ which, as well as crossing a number of tracheids, traverses the lumen of a wood parenchyma cell.

Generalizations regarding a primitive position for the Betulaceæ which are based on the occurrence of trabeculæ in members of this group must be hazardous as the ubiquitous distribution of these typically rod-like structures in the Gymnosperms leads to the presumption that they may be of widespread occurrence in the Angiosperms as well.

J. D. Hale
Forest Product Laboratories of Canada,
Montreal

A COURSE IN PHYSICAL MEASUREMENTS FOR STUDENTS IN OTHER SCIENCES

In the issue of Science for August 29, 1919, a plea was made by Dr. Paul E. Klopsteg for courses in physical measurements for students of chemistry and related sciences. In view of the inherently physical nature of almost all quantities which can be observed and evaluated, the reasonableness of such a plea seems obvious. The emphasis of the writer was upon the need of training in physical measurements as differentiated from "physics."

During the past semester we have offered a course of this type and it seems advisable to add our experience to the plea made by Dr. Klopsteg. The section has consisted of ten men, seniors and juniors, whose major interests have been in astronomy, chemistry, engineering and mathematics. All have pursued a course in general physics which included a year of laboratory practice of the ordinary college type. Each one has had laboratory experience, more or less extended, in some other science.

The material for the course was determined by choosing from the instruments commonly employed in the physical laboratory those which were judged to have application in other fields. Opportunity was given for becoming familiar with each instrument by using it for some particular determination. The method of its use was stressed rather than the quantity which was being determined. For instance, the potentiometer was studied in principle and one was used in calibrating a thermocouple. The choice of instruments has been influenced by the resources of the laboratory and the list here given is not to be taken as a final selection. In each case the particular use to which the instrument was put has been indicated.

1. The Pulfrich refractometer for the index of pure liquids, solutions and solids.
2. The prism spectroscope with photographic registration of an "unknown" and a comparison spectrum, measured with a comparator.
3. The alternating current bridge and galvanometer for electrolytic conductivity, using an electrically controlled thermostat.
4. The Carey-Foster bridge for the checking, coil by coil, of a decade box against a standard.
5. The potentiometer in the calibration of a base metal thermocouple.

6. The Kelvin double bridge (Wolff type) in calibrating a platinum resistance thermometer.

7. The MacLeod gauge, with double range, measuring the pressure produced by an oil and a mercury diffusion pump in the various stages of the discharge in an attached Geissler tube.

8. The triode amplifier. Its static characteristics and its amplifying factor were measured. Its application was discussed but not made.

The emphasis of the course has been upon the use and application of specific instruments and upon the principles governing measurements in general and not upon the physical theory involved in the experiments. It is debatable how far this distinction may be carried with profit, but our first experience seems to justify for such students this type of course. There is no doubt of the appeal which it has made to the men and of their conviction of its value in preparing them for their chosen fields. We feel that physicists owe it to their fellow-workers to make their instruments of precision more widely known and propose courses of this general nature as a step in that direction.

Winthrop R. Wright

Swarthmore College

BIOLOGICAL RECORD CARDS

For a number of years there have been in use in the zoological laboratory of Harvard University small record cards of the standard library size (75 m.m. by 125 m.m.), similar to the first of the illustrations printed below. These were devised primarily for use in keeping permanent card records of the treatment of histological and embryological material, but are serviceable for recording any procedure or experiment with animals or plants in which a time record is important. The time-saving helpfulness of such cards has been recognized by persons in other laboratories and this has suggested the possibility that the cards might be useful in many laboratories if they were readily procurable.

The method of use is shown in the second of the accompanying illustrations. The serial numbers indicate successive steps in the treatment of the object. The *printed* numerals are the "units" only; the "tens" are to be *written* in front of each "0." By ignoring the last four lines, the steps in a series can be carried to any desired number, the second card beginning with step 21, the third with 41, etc.

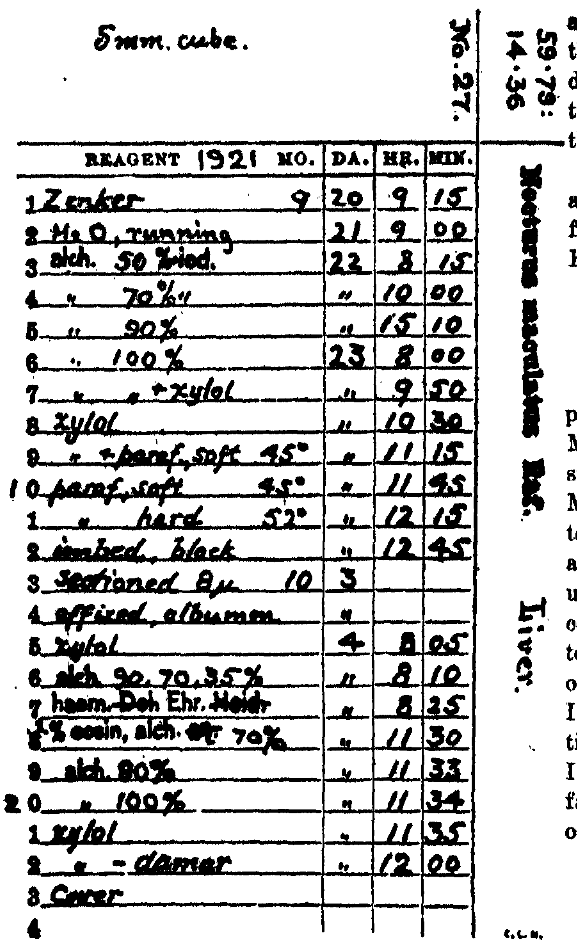
In the column headed "Reagents," abbreviated names can be used and, if one desires, small rubber stamps may be procured for the more common reagents, as illustrated in parts of lines 3 and 16-19. Sometimes several methods may be indicated on a single stamp, all except the one employed being stricken out, as in 17, where the staining was in Ehrlich's haematoxylin.

The time record shows the instant at which the treatment begins, it being assumed that that treatment continues till the beginning of the next following one. The period during which any treatment lasts is *not* to be recorded; but can be determined at once by noting the difference in time between the beginning of the treatment and the beginning of the one next

REAGENT	MO.	DA.	HR.	MIN.
1				
2				
3				
4				
5				
6				
7				
8				
9				
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
0				
1				
2				
3				
4				

E. L. M.

Fig. 1



5mm. cube.

No. 27.

14.36

59.79

Necturus maculatus Raf. Liver.

REAGENT 1921 NO.	DA.	HR.	MIN.
1 Zenker 9	20	9	15
2 H₂O, running	21	9	00
3 alch. 50% iod.	22	8	15
4 " 70% "	"	10	00
5 " 90%	"	15	10
6 " 100%	23	8	00
7 " " + xylol	"	9	50
8 xylol	"	10	30
9 " + paraf. soft 45°	"	11	15
10 paraf. soft 45°	"	11	45
1 " hard 52°	"	12	15
2 imbed. block	"	12	45
3 Sectioned 8μ 10	3		
4 affixed, albumen	"		
5 xylol	4	8	05
6 alch. 90, 70, 35%	"	8	10
7 haem. ~~Del~~ Ehr. ~~Heidr~~	"	8	25
8 1% eosin, alch. ~~of~~ 70%	"	11	30
9 alch. 80%	"	11	33
20 " 100%	"	11	34
1 xylol	"	11	35
2 " - damar	"	12	00
3 Cover			
4			

E.L.M.

Fig. 2

following. It is important to avoid the use of A. M. and P. M., which may best be done by adding 12 to the afternoon hours, which thus become 13, 14, 15, etc., instead of 1 P. M., 2 P. M., etc.

The three blank spaces at the margins of the cards can be used to suit the needs of the individual. The suggestions offered by the accompanying sample imply filing the records as with bibliographic cards. The long margin carries the name of the animal[1] (or plant) and also that of the organ. If the Dewey decimal system, as expanded by the *Concilium Bibliographicum*, is used for the systematic arrangement of the cards, the space in the upper left-hand corner may receive the numerals, as in the sample, where "59.79" represents "tailed amphibia" and "14.36" stands for "anatomy of the liver." In the shorter margin "No. 27" indicates the number of the individual (or organ) treated in this manner and "5-m.m. cube" shows the size of the object so treated.

The printed cards are of heavy ledger paper and can be had by the hundred or thousand from the Harvard Cooperative Society, Inc., Harvard Square, Cambridge 38, Mass.

E. L. Mark

AEROBIC

Dr. Keen's rejoinder to my comments on his proposed spelling of the word aerobic (Science, May 11, p. 559) can hardly pass unnoticed. He states that I have misread his letter (Science, March 23, p. 360) and that he "urged the retention of the aer as a disyllable." Referring again to his first letter, I find that Dr. Keen used the diphthong four separate times in this connection and no reference whatever is made to a "disyllable." With regard to the spelling of dissylable to which Dr. Keen takes exception I find that Webster's New International Dictionary gives only the spelling with double s. If Dr. Keen will refer again to my letter he will fail to find the spelling "dipthong" to which he objects.

Arthur W. Dox

Detroit, Mich.

QUOTATIONS

THE ZOOLOGICAL RECORD

The decision of the Zoological Society's council to discontinue the publication of the *Zoological Record* on the grounds of expense suggests somewhat opposing thoughts. It is generally admitted, or even strongly urged, by most workers in every branch of science that some guide to the ever-increasing flood of literature is a necessity. If this was true in 1865, when the *Zoological Record* was started, it is no less true to-day. The need, in fact, must have increased in at least the same direct ratio as the number of publications. Yet in zoology, as in geology and other sciences, these guides, records and indexes have had a perpetual and severe struggle for life, in the course of which many have from time to time succumbed, been revived under another form and too often again collapsed.

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[1] For maculatus read maculosus.

The *Zoological Record* itself was begun in 1865 as a publication by Van Voorst, under the editorship of Dr. Albert Günther, with a distinguished staff of recorders. The publisher paid for the printing, but the manuscript, we believe, was compiled for nothing. Mr. Van Voorst soon found the loss too great, and, though he continued as publisher, an association was founded in 1871 to guarantee the expenses. This carried on till 1887, when the *Record* was saved from extinction by the Zoological Society, which generously shouldered the burden and bore it unaided until the establishment of the International Catalogue of Scientific Literature. The question then arose whether the record of zoology should merely become one part in that vast scheme. Fortunately the secretary of the Zoological Society was far-sighted enough to preserve the continuity and title of the record and the control of the society, by inducing his council to contribute largely to the expense and to maintain its record committee. Consequently, when the International Catalogue failed, and when the Royal Society declined to undertake the huge expenditure on what had virtually become its sole responsibility, then zoologists still found their record appearing—retarded and weakened, but in being and ready to resume its old strength and value whenever they themselves would provide the necessary sustenance. Unfortunately, the increased costs of production have coincided with the loss of a number of subscribers owing to the effects of war and its *sequelæ*. The secretary of the Zoological Society has over and over again sought in various directions to supply this loss, but has not met with any cheering response. All these facts must be remembered before we venture to blame the society for its present decision. * * * *

For thirty-six years the Zoological Society has earned the thanks and praise of zoologists for its support of this indispensable aid. But zoologists at large must now do their share if they wish this support to continue. On their side, as well as on that of the recorders, there must be a little more enthusiasm and self-sacrifice. The vessel is stranded, but with good will from all hands she can be kept afloat till the high tide returns. If the workers will give some real earnest of this good will, we can not believe that the society which has so long served as pilot will leave her to be broken up.—*Nature.*

SCIENTIFIC BOOKS

THE NEW VOLUMES OF THE ENCYCLOPAEDIA BRITANNICA

MY experience as a reader of the *Encyclopædia Britannica* has been so intimate and long continued that I may perhaps be allowed to undertake what no one person can do perfectly, namely, the writing of a review of the three new volumes which were recently added to the twenty-nine volumes of the eleventh edition to convert it into the twelfth.[1] A lifetime given wholly to the study of such an extensive and varied work would not suffice as a suitable preparation for analyzing it adequately. It was the ninth edition which first stimulated my intellectual life and afforded me the earliest means of entry into the wealth of the world's culture; and I have never ceased to look upon this magnificent work with affection and gratitude. The eleventh edition marked an immense improvement over the preceding ones, excellent as these were; and it gave me a new lease of enjoyment of the intellectual heritage of our humankind. My occasional and partly systematic reading of the *Britannica* during the last eleven years has taken me through more than ten per cent. of this eleventh edition, and I have now read nearly as large a portion of the new volumes.

It is needless to say that in the field of my specialty the *Britannica* is too brief to serve my purpose. If it was sufficient for the specialist in every field it would be too large for general use and would lose its primary value as a storehouse of that knowledge and culture which is available and suitable for the general needs of educated men and women everywhere. The chief value of every such work must consist in the fact that it makes available to all intellectually minded persons the most important achievements of human thought and action in every division of endeavor which is essential to the civilization of the time. The contributions must therefore be broadly conceived and the work must be executed along lines which are not too technical. This is difficult if one is to achieve the character of authoritativeness which is necessary if the work is to be consulted with confidence. With respect to these ideals of clearness, of non-technicality, of authoritativeness, the eleventh edition of the *Encyclopædia Britannica* has succeeded more fully, I believe, than any other publication in any age or in any language; and the new volumes, under the same editorial management as the eleventh edition, have maintained a similar excellence.

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[1] *The Encyclopædia Britannica*, The New Volumes, constituting, in combination with the twenty-nine volumes of the eleventh edition, the twelfth edition, 1922.

In the 155 years since the *Britannica* made its first appearance in 1768 there has been a single occasion on which a new edition or a supplement to a previous edition appeared under circumstances comparable to those which existed at the time of the publication of these new volumes. During the years 1816 to 1824 there was published, under the editorship of Macvey Napier, a six-volume "Supplement to the fourth, fifth and sixth editions." This supplement was conceived in response to the pressing demand for a review of the world's situation immediately after the great wars of Napoleon which had just ended at Waterloo in 1815. It formed the only critical and universal survey then available for the troubled period to which it referred. Much of the information brought together in this supplement was of permanent value; and some of it could never have been procured if it had not been put on record at that time.

A similar need and a similar opportunity lay before Hugh Chisholm, the present editor of the *Britannica*, as he (just a hundred years later) undertook the task of organizing the material for the "new volumes" to cover the period from 1910 to 1921. He had an important advantage over his predecessor. The new volumes were prepared simultaneously and their publication took place practically at once. The whole work could therefore be under editorial supervision at one time. This gives greater unity to the text and puts the entire work at once into the hands of the reader.

There exists at present no other work comparable to these new volumes as a survey of the period of the Great War. They are arranged, as the editor says, "so that the articles may be adapted either for continuous reading or for occasional reference." They "have been planned as a guide to an appreciative understanding of contemporary affairs." In these volumes "the reader has before him what may be described as an international stock-taking" based on the comprehensive view of human culture afforded by the eleventh edition. There is never a way to understand the present, and especially a present so complicated as ours, except by seeing it in the light of the past. "The eye which looks only at the passing scene is too often color-blind." Our post-war world cannot be understood without a knowledge of our pre-war world. To behold current events in perspective we must employ the searchlight of the past. In this respect the preparation of the "New Volumes" was greatly facilitated by the existence of the eleventh edition completed only a short time before the outbreak of the Great War. No such cross-section of human progress as that contained in the eleventh edition could be taken now or can be taken at any time for some years to come. It is particularly fortunate that that great work was produced near the end of the long period of calm preceding 1914 when men could give themselves coolly to the task of evaluating the elements of human progress. The existence of such a work as the basis and starting-point of the "New Volumes" gives them an important advantage over any other survey of the war period likely to be produced in the near future. These new volumes are therefore an almost essential prerequisite to the needed stock-taking of our times.

The break-up of society following the Great War has so much turned attention everywhere to conditions of urgency and emergency and has so concentrated thought upon the immediate conduct of life and has so reduced experts everywhere, both in scholarship and in science, to the necessity of living (as it were) from hand to mouth and has so interrupted or suspended the accustomed intellectual activities that it has become a difficult matter to find intellects which are ready for the task of constructive analysis necessary to produce a work which meets the standards of the *Encyclopædia Britannica*. In this difficult undertaking the editor has succeeded remarkably well. He has even been able to revive something of the international cooperation which was so useful in the preparation of the eleventh edition. The English speaking portion of the more advanced part of the world has been less dislocated from its intellectual foundations than any other portion; it is therefore natural that the first carefully planned universal stock-taking since the war should be carried out by them. Nowhere else has it yet become possible for such a work to be performed adequately.

It is inevitable that the Great War should loom large in these new volumes, and it is equally inevitable that they should be prepared under the assumption and the conviction that the war "was won by those who had right and justice for their cause" and "the historical justification for this belief is indeed given in the proper articles." By starting with the article on "The World War" and by employing the summary and references given in it the reader may easily organize for himself a systematic course giving an elaborate and authoritative history of the whole conflict.

Necessarily, the war and those things which grew out of it hold a prominent place throughout the "New Volumes"; it is this which gives to them a large part of their value. But the work as a whole is much more than a history of the war, much more indeed than the larger general history of the whole period of the war. All aspects of human progress and culture and knowledge for the period of 1910-1921 are taken into account; and the roots of some of the recent developments are traced far back to their beginnings. In this way some deficiencies of the eleventh edition are removed, as in the articles on Relativity, Protozoology and Nomography, for instance. The filling in of these gaps increases the usefulness of the earlier volumes and serves to complete the survey afforded by them. It is a matter of considerable surprise to me that so few of these gaps have been discovered. I do not know of any that escaped attention, and yet the number of important gaps filled in is very small. This makes clear as nothing else could the extraordinary adequacy of the eleventh edition.

Where the range of subject matter is so great as that in an encyclopedia a selection of the more valuable articles made by any one person will necessarily reflect his interests more than the character of the work itself. But it may be worth while to mention a few of the special topics which attracted my attention other than those dealing with the history of the period. No attempt will be made to indicate the more important articles as such; I intend rather to select some which appealed to me, and particularly those which one might perhaps overlook if his attention was not directed to them.

The article on Protozoology goes back to the beginning of that science; the account of its subject given in it affords very fascinating reading. In the article on Agriculture there is an equally interesting and related section on the "Progress of scientific research." The article on Geology should have many readers; this is especially true of the first two divisions of it. That on Anthropology is remarkable; in it we have a different view of the subject from that given in the eleventh edition. Under the heading of Relativity is found a brief and clear account of a modern subject which has attracted more general attention perhaps than any other subject in science has ever drawn to itself. Some of the surveys of recent national literatures are very entertaining; others are less so, and some are perhaps even a little disappointing. The articles on the electrical properties of gases and the constitution of matter are masterpieces of scientific writing. An excellent account of the League of Nations is given. The articles on Philosophy, Psychical Research and Palaeontology are fascinating. That on Zoology is a masterpiece. The one on mathematics is very pleasing, but the greater portion of it is too technical for one not well versed in this exacting science. Among other articles which I found very interesting are the following: Cytology, Archaeology, Astronomy, Botany, Chemistry and Embryology. In a survey which reviews the principal sciences under their general names it is somewhat surprising to find no article with the title Psychology. By some this may be counted a real omission. But there is an interesting article on Behaviourism. That this in a way takes the place of an article on psychology is significant of certain present tendencies in psychological investigations—tendencies which (in my opinion) are likely soon to give way in part to those in the opposite direction.

My examination of these volumes has revealed remarkably few defects. The index will probably not prove to be as good as it might have been made, if one may judge from the omissions detected by looking occasionally to the index for references to interesting passages which were being read. One misses the "Classified table of contents" promised on the title page to the last volume but not supplied (at least in the copy I have and in one other which I consulted). The few pages required for this would have added greatly to the value of the work as a whole. But the defects are so few and the merits are so many that one should probably forget the former in his enjoyment of the latter. The distribution into articles is along the lines of an almost ideal arrangement; and the articles which I have read maintain generally a very high degree of excellence.

It remains to mention one other feature which should commend the work to all English speaking peoples. We may put this in the words of the editor, as given in the preface. "In the material structure of the New Volumes, and their sub-editing, the same note of Anglo-Saxon solidarity is struck as in the Eleventh Edition; and this is again emphasized by their being dedicated jointly to the two Heads of the English-speaking peoples, by express permission of King George V and President Harding. Nowhere except in Great Britain and the United States would it have been possible, under the world conditions of 1921, to find the standard of poise and perspective required in their construction." In concluding his preface, written after twenty-one years of continuous service as editor of the *Encyclopædia Britannica*, Hugh Chisholm says: "As architect both of the Eleventh Edition and of the superstructure which now converts it into the Twelfth Edition, it has been the present writer's privilege to be served by an international company of practical builders, supplying the world's best available materials and masonry; and he has been inspired by the ambition of cementing and adorning, in the completed edifice, that great movement for Anglo-American cooperation, on whose progress from strength to strength the recovery of civilization after the World War of 1914-19 must so largely depend."

R. D. Carmichael

University of Illinois

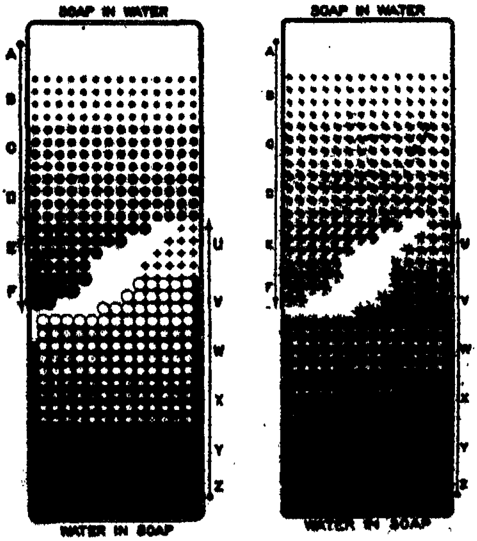
SPECIAL ARTICLES

ON THE ELECTRICAL RESISTANCE OF PHENOL WATER SYSTEMS AND OF PROTOPLASM

I

We have tried to show in previous communications[1] that the characteristics of lyophilic colloid systems are best explained on the assumption that they are mutually soluble systems of the type phenol/water, butyric acid/water, etc.

Any lyophilic colloid system (like soap/water or protein/water) is, like phenol/water, capable of forming two types of solution, one of phenol in water and a second of water in phenol. When an ordinary soap/water system is permitted to cool, say from 100° to room temperature, it changes from the first of these two types of solutions to the second. In the course of such change two zones of mixed systems are passed which are of special significance. As shown



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[1] Martin H. Fischer and Marian O. Hooker, Science, xlviii, 143 (1918); Martin H. Fischer, Science, xlix, 615 (1919); *Chemical Engineer*, xxvii, 186 (1919); Soaps and Proteins, 64, New York, 1921.

in the diagrams of Figure 1 we pass from the original non-colloid, "molecular" or "ionized" "solution" of soap in water (zones A) through a first type of mixed system which is a dispersion of solvated soap in soaped-solvent (zones B, C, D, E) into a second which is a dispersion of soaped-solvent in solvated soap (zones V, W, X, Y). At the bottom lies the second type of true solution which we have called water in soap (zones Z). All the systems between the true solution at the top and the true solution at the bottom are, if the dimensions are correct, "colloid."

This concept explains readily the "peculiarities" of the so-called lyophilic colloid systems. Obviously it sets no limitations upon the nature of the materials that may make up such a colloid system and makes no specifications as to the nature of the forces which guarantee its stability. They are any or all which may appear or be operative whenever "solution" of any kind occurs. Electrical notions of colloid stability are at present particularly acceptable. But how can such be the dominant factors in those most typical lyophilic colloids which consist of nothing but nitrocellulose with ether and alcohol, agar-agar with water, or rubber with benzene? They are of minor significance even in those lyophilic colloid systems which are composed of an "electrolyte" and water (like soap/water). The most stabile of these systems show the least evidences of electrical charges. When such appear they are not the cause of the colloid behavior but the accidental consequence of having an overplus of "solvent" present in the system into which some of the soap has gone in true solution with secondary hydrolysis and electrolytic dissociation.

The concept of the solvated colloid as here outlined clarifies the concepts of *hysteresis, gelation capacity, swelling* and *syneresis.* Hysteresis is the expression of the fact that solution takes time, wherefore two mutually soluble substances can not quickly come to equilibrium. The point at which a lyophilic colloid "gels" is (zones F) that at which the solvated colloid phase becomes the external one. The system as a whole still carries at this point as an internal phase a solution of the colloid in the solvent. The combination marks the gelation capacity of a colloid with its solvent and is always greater than the solvation capacity of the colloid. The latter is a measure only of the solubility of the solvent in the colloid material. The increase in the volume of the latter as the solvent is taken up measures its ability to "swell." The zone Z in the diagrams covers the swelling capacity of a given material with its solvent; the gelation capacity embraces all the zones above this up to and including the zone V. As soon as this zone is passed the external solvated colloid phase may not inclose all the solution of colloid in solvent wherefore the system as a whole begins to sweat; in other words, exhibits the phenomenon known as syneresis. Colloid systems in which one of the mutually soluble materials is solid (diagram B) will obviously fail more easily to inclose adequately the internal phase than will such in which both materials are liquid (diagram A), wherefore colloids of the type sodium stearate/water, silicic acid/water, etc., show a greater liability to syneresis than more liquid ones like sodium oleate/water, rubber/benzene, etc.

II

Our various colloid-chemical studies during the past years have demonstrated the analogies which exist between the behavior of lyophilic (hydrophilic) colloids and living cells. Not only are the laws which govern *water* absorption or secretion[2] by the former identical with those which govern water absorption or secretion by living cells but the absorption and secretion of *dissolved substances*[3] is identical in both. The analogies between living matter and lyophilic colloid systems demand that the former find some place in the diagrams of Figure 1. The physico-chemical properties of protoplasm are such as place it definitely in the lower regions of the diagrams. Protoplasm is essentially, in other words, a solution of water in protoplasm. The more solid structures of the body never, normally, lie above the middle of the diagrams and even such liquid protoplasmic structures as blood and lymph can not lie much above the level E. The more aqueous *secretions* from the body, on the other hand, like urine and sweat, approximate the level A (that of the true solutions) though even these, through admixture with colloid substances (colloid salts and proteins) are better comparable to levels like B or C. The physical chemists have for the most part sought the solution of physiological behavior by trying to rediscover in living matter the laws of the dilute solutions. But protoplasm does not lie in or near the levels A of the diagrams but nearest the levels Z. *The physico-chemical laws which govern systems of this type are those which are most likely to find unobjectionable applicability to protoplasm.*

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[2] Martin H. Fischer, Physiology of Alimentation, 268, New York, 1907; *Am. Jour. Physiol.*, xx, 330 (1907); *Pflüger's Arch.*, cxxiv, 69 (1908); *Ibid.*, cxxv, 99 (1908); *Ibid.*, cxxvii 1 (1909); *Ibid.*, cxxvii, 46 (1909); or in connected form in Oedema and Nephritis, Third Ed., New York, 1921.

[3] Martin H. Fischer, Oedema, 202, New York, 1910; or Oedema and Nephritis, Third Ed., 206, 301, 315, 367, 393, 640, New York, 1921.

III

The system phenol/water in its two phases, water-dissolved-in-phenol and phenol-dissolved-in-water yields in handy laboratory fashion the analogues respectively of the zones Z and A of the diagrams of Figure 1. Protoplasm is comparable to the solution of the water in the phenol; the secretions from the body to the solution of the phenol in the water. It is the purpose of this paper to discuss especially the electrical conductivity of the former.

1. Carefully purified phenol shows a very high electrical resistance (over 210,000 ohms) when measured in the customary fashion with a fixed pair of platinized platinum electrodes of the dip type (of the constant .0793) with a Wheatstone bridge arrangement and a telephone. The addition of water in increasing amount to such pure phenol progressively decreases its electrical resistance until when saturated with water (at 20° C.) it shows under laboratory conditions a resistance of not less than 21,000 ohms.

2. Our experiments were performed by adding to 50 c.c. of liquefied phenol 50 c.c. of water or the solutions to be discussed. It needs first to be pointed out that the phenol under such circumstances takes up the water and increases its volume. The phenol, in other words, "swells." When thus "swollen" through saturation with water the basal resistance of 21,000 ohms is registered. The addition of acid or alkali to the phenol/water system reduces the electrical resistance of the hydrated phenol phase. When enough of either is added the resistance of the phenol phase becomes so low as to approximate the values shown by solutions of phenol in water. At the same time that this change occurs the volume of the phenol phase also changes. Acid decreases it slightly but alkali progressively increases it. In common parlance the phenol "swells" more in the presence of an alkali than in pure water.

3. At the same normality different alkalies are unequally effective in reducing the electrical resistance of hydrated phenol, potassium hydroxide, sodium hydroxide and calcium hydroxide being progressively less effective in the order named.

4. The addition of any single neutral salt to a phenol/water system also lowers the electrical resistance of the phenol phase but not as much as do acids or alkalies. The nature of the salt employed and its concentration, however, make a difference. With progressive increase in the concentration of any single salt there is at first a decrease in electrical resistance of the phenol phase to be followed later by an increase. The volume of the hydrated phenol phase is progressively reduced with successive increments in the concentration of the added salt. When salts of a common base but with different acid radicals or salts with a common acid but with different basic radicals are compared at the same molar concentration or at the same normality, they prove unequally effective in reducing the electrical resistance of hydrated phenol. While the radicals differ even within the same group it may be stated as a general truth that monovalent radicals decrease the resistance of hydrated phenol more than divalent radicals and these more than trivalent ones.

5. Since salts show differences in reducing the electrical conductivity of hydrated phenol it is an easy matter to demonstrate an "antagonism" between them. The gradual substitution of a bivalent salt (like calcium chloride) for the sodium chloride in a sodium chloride solution therefore "antagonizes" the electrical resistance-reducing effect of the latter.

6. The addition of anhydrous ethyl alcohol to a phenol/water system at first lowers the electrical resistance of the hydrated phenol (though not as markedly as does the addition of an electrolyte) and then increases it to twice

the figure characteristic of the pure hydrated phenol. But the effect of the alcohol upon the volume of the phenol phase is a progressive one, each added amount of alcohol increasing it. When different monatomic alcohols are compared, it is found that only the lower members bring about a decrease in the electrical resistance, all the higher ones increasing it. The lower alcohols also make the phenol phase "swell" more than the upper ones.

IV

These findings are of significance for a better understanding of certain aspects of cell behavior, more particularly the phenomena of "permeability" of "cell membranes" or of "protoplasm" in general. The attempt is still being made to understand these phenomena through some modification of Pfeffer and De Vries' osmotic concept of the living cell or Overton's lipoid membrane modification of it. The physico-chemical and biological objections which may be raised against either of these notions are too numerous to need repetition here. The living cell is capable of absorbing and secreting water, of absorbing and secreting the most varied types of dissolved materials, the two moving at times in the same direction and at times in the opposite direction. There can be no adequate physico-chemical concept of the living cell which does not contain within it the possibility of understanding all these characteristics at one and the same time. The volume of the hydrated phenol phase described above "swells" and "shrinks" when subjected to the action of alkalies or of salts, shows, in other words, the biological phenomena of plasmoptysis and plasmolysis, just as does any hydrophilic colloid (protein) or the living cell. But such a phenol system shows also the "strange" phenomena of permeability to dissolved substances so characteristic of living matter. It is quickly permeable, for example, to the most varied dyes; to another group of such or to iodine it is less permeable. While permeable to the salts, hydrated phenol takes these up most slowly and in certain instances practically not at all. Identical observations are characteristic of protoplasm and the living cell.

The high electrical resistance characteristic of living matter has always been difficult to understand as long as we held to the view that protoplasm was essentially a somewhat modified *dilute solution*. In spite of the conclusion that a physiological salt solution is supposed to be osmotically comparable with the salts dissolved in a living animal or its body fluids, the former will register only 1/5 to 1/35 the electrical resistance of the latter. This old biological truth can be understood only by denying to the salts found in protoplasm any large existence in uncombined form or by concluding that the cell is a different sort of solvent for these salts than is water. Experimental evidence supports both these conclusions. Aside from the fact that the electrolytes are for the most part "combined" with the protoplasmic constituents and are not "free" as in an ordinary salt solution, the high electrical resistance of protoplasm is further accounted for as soon as it is remembered that protoplasm is not a solution of protoplasmic material in water but of water in protoplasmic material, one comparable in other words, to the solution of water in phenol. The effects of acids, of alkalies, of single salts, of anesthetics, etc., all of which reduce the normal electrical resistance of living matter, are then to be understood in the same terms in which these factors reduce the electrical resistance of systems of the type, hydrated phenol. Even the physiological antagonism between different salts so characteristic of living matter reappears in the case of hydrated phenol.

V

What has been said above for phenol/water systems is true of many other mutually soluble systems. Quinoline, for example, behaves much like phenol and what has been said of these substances holds also for the lower fatty acids, the soaps and the various proteins.

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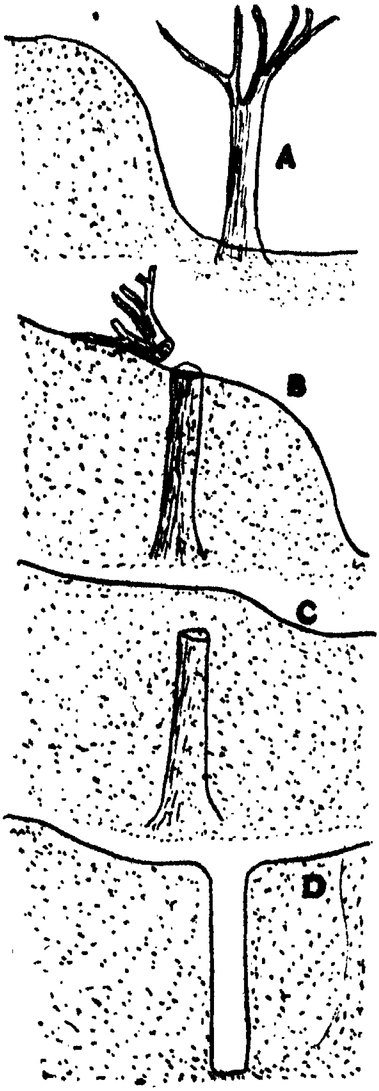
THE ORIGIN OF COLUMNAR HOLES IN WANDERING DUNES

The forests which existed on the New Jersey sand strands at Wildwood, Holly Beach, Peermont, South Atlantic City and South Seaside Park have been almost entirely destroyed, except at South Seaside Park and Peermont. The forest at the latter place has been invaded by wandering dunes, the highest of which are about forty feet, or the height of the tree tops. The formation of these dunes is due to the trees, which break the force of the wind, so that the sand accumulates on the seaward side of the forest. The accumulation of sand is followed by its encroachment on tree growth, so that the forest is narrowed gradually. The trees, which were buried by the advancing sand, have in some cases persisted without decay, especially the red cedars, and as dead trees they form a forest graveyard with the bleached stumps as monuments sticking through the dune sand, which has drifted away from such dead and buried trees with the action of the fickle wind. Fifty years hence little will remain of this forest of red cedars, hollies, post oaks, Spanish oaks, red mulberries, sour gum trees, hackberries, etc. The wandering dunes will have covered and destroyed the remaining trees. This forest destruction has been going on for a long time and between the highest dunes and the sea beach at Peermont, New Jersey, is the dune complex corresponding in area with the forest graveyard (A).



The tops of the buried trees have decayed at the surface of the dune sand (B) and the branches have been broken off and have been carried away by the wind, or have been buried in situ by the drifting sand. The trunks of the trees have been covered with sand (C). If of destructible wood (the red cedars alone remaining without much decay), the tree trunks of such species disappear by decay and there is left a cylindrical cavity the exact height and other dimensions of the tree trunk, which before decay formerly filled it. Such decay is absolute, for when the columnar hole is uncovered there are found no remains of the tree which formed it. If there are any remains of the bark and the wood of the trees, they have dropped to the bottom of the hole and have been covered by the sand which has fallen from above into the depressions. These columnar cavities are roofed with compacted sand and with the removal of the sand by wind action, there is a change in the configuration of the dunes, and in the lowering of the dunes the columnar holes are uncovered. The upper edges of the holes slope inwardly (D) and leaves and blades of grasses and the tops of the tumble grasses *(Eragrostis pectinacea)* fall into the depressions, which are sometimes six to eight feet deep and a foot in diameter.

As far as the writer is aware the origin of these holes has never been described, although Dr. Seneca Egbert, of the University of Pennsylvania, has informed him that he had discovered them over thirty years ago at Peermont by breaking through the roof of one. The accompanying sketches will make clear the sequence of events in the formation of the columnar holes in the wandering dunes at Peermont, New Jersey.

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ANCIENT FAUNA OF MONGOLIA DISCOVERED BY THE THIRD ASIATIC EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY[1]

IT is a very significant fact in the history of palaeontology that the homeland, or chief center of evolution or adaptive radiation, of the mammals during the Age of Mammals and of the reptiles during the Age of Reptiles is the very last to be explored. Beginning with the first palaeontological work toward the close of the eighteenth century in Europe, continuing with the thorough exploration of Europe and southern Asia during the nineteenth century and with the wonderful discoveries in reptilian and mammalian history in North and South America from the middle of the nineteenth century onward, the homeland was still left untouched, unexplored. Discoveries in North America were so extensive and so revolutionary that many thought the homeland had been revealed in our great western fossil beds. Positive claims were advanced by Ameghino for Patagonia as the homeland of proboscidea and primates. As a residuum of these discoveries in the western hemisphere, it proves true that several orders of mammals did originate in the Americas, but the ancestral stock from which these orders radiated was still to be found. Speculation wavered between the northern hemisphere and the southern hemisphere and some zoologists advocated both hemispheres in so-called bipolar theories. Thus sprang up two new branches of science—Paleogeography and Paleometeorology—centering in more or less inductive and deductive schools of thought.

In 1889 the New York Academy of Sciences adopted a new rule, namely, that its presidency should be held not for long terms but for two-year terms, and a new condition of the presidency was the preparation of a serious presidential address. In accepting this responsibility and honor the writer took the task very seriously, retired to the most secluded spot in the American Museum, namely, the sixth floor of the southeast tower, and, aided by his colleague, William K. Gregory, began to attack the problem of the homeland of the mammals. The results of two very hard years' work were delivered in the two successive winters of 1899 and 1900 and published by the academy in 1900.[2] In these addresses the succession of mammalian life in western Europe as studied by Charles Depéret was for the first time compared step by step with the succession of mammalian life as known in North America. Parallels previously drawn, especially those of Edward D. Cope, were pointed out; others were added. It was found that there was remarkably close resemblance between the life history of Europe and that of the Rocky Mountain region; there are some interludes of separation, but in the main there are longer periods of affinity. Consequently we confirmed Joel A. Allen's generalization that Sclater's division of the northern hemisphere into Palaearctica and Nearctica should be united into a single holarctic province and proved that Holarctica extended back as far as the Lower Eocene period of the Age of Mammals.

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[1] Address to the New York Academy of Sciences at a special meeting May 21, 1923.

Two other generalizations followed: first, that Africa must have been an important and independent center of mammalian evolution during the whole period of the Age of Mammals; second, that in Africa there probably originated four great orders of mammals, namely, the Proboscidea, the Hyracoidea, the Sirenia and the ancient whales, Archaeoceti. Of these, traces of Sirenia and the ancient whales had already been found. Two years later this generalization was confirmed by the discovery of Beadnell and Andrews in northern Egypt of the ancestors of Proboscidea and of the Hyracoidea, namely, primitive mastodons and primitive coneys.

The third generalization was of even a more sweeping character and had been adumbrated more or less clearly by many zoologists and palaeontologists from the time of Buffon; it was that the chief homeland of the mammals was not in Africa nor in southern Asia nor in Europe nor in either of the Americas, but in the unexplored regions of the roof of the world, namely, of the central plateaus north of the Himalayas. These third and fourth generalizations are expressed in the paleozoologic map. A similar theory was subsequently advocated by J. L. Wortman and was set forth with very great fullness by William D. Matthew in his well known paper published by the academy.

How far this succession of addresses and papers fired the imagination of Roy Chapman Andrews we do not know, but it may be clearly stated that the chief object of the Third Asiatic Expedition was the exploration of the unknown roof of the world. The results have far surpassed our fondest hopes. Far more than a new chapter—a new *volume*—has been opened up in the history of the earth. Central Mongolia proves to be the homeland not only of the *Mammalia* but of the *Reptilia* as well; a single year's work (1922) demonstrates this, and the present season of 1923 will confirm and extend it and will, we hope, reveal the mammals of the basal Eocene and upper Cretaceous, as yet undiscovered. Roy Chapman Andrews, leader of the expedition, was prepared for his very responsible task by several preceding years of exploration in China. The territory he explored in 1922 had been crossed by Raphael Pumpelly in 1862-65; by Richthofen in 1877, who named these Tertiaries the Khan-Khai beds; by Obrutchev in 1892-94, who applied the name "Gobi Series" to the tertiary sediments; and by Chernov in 1908.

As developed in China, the underlying series of rocks, from the Jurassic downwards, had been described by von Richthofen and later by Bailey Willis in his researches in China of

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[2] 1900.182. The Geological and Faunal Relations of Europe and America during the tertiary period and the theory of the successive invasions of an African fauna. *Science*, N.S., Vol. xi, No. 276, Apr. 13, pp. 561-574.

1900.187. Correlation between tertiary mammal horizons of Europe and America. An introduction to the more exact investigation of tertiary zoogeography. Preliminary study with third trial sheet. . . . *Presidential address before N. Y. Academy Sci.* delivered February 26, 1900. With a list of the author's scientific publications, 1878-1899, appended by direction of the Council of the Academy. *Ann. N. Y. Acad. Sci.*, Vol. xiii, No. 1, July 21, 1900, pp. 1-72.

1907. Our geologic party found a great unconformity separating the folded sediments of Jurassic and earlier time from all of the desert basin sediments; after the Jurassic period the marine sediments of the roof of the world ceased. Above the Jurassic and also above the Great Unconformity, sediments are entirely epicontinental—*this Cretaceous-Tertiary continent constituted the homeland of the chief orders of reptiles and mammals!*

The series underlying the Great Unconformity from the Archean to the Jurassic had been recognized by Willis in China, and that pioneer work was of great help to the geologists of the expedition. The Nan-K'ou Series of China seems to be continuous across Mongolia. A great bathylith was found by our party invading these older metamorphic rocks and extensively exposed by erosion. It is on this complex erosion floor that all of the later Cretaceous-Tertiary strata were laid down, some of which were again swept away by the Post-Jurassic interval. The Later Mesozoic and Cenozoic sediments of Mongolia lie upon the peneplaned surface of this complex of old deformed rocks with its Great Bathylithic Invasion. This is a wide contrast to conditions in the Rocky Mountain Plateau region of America, where marine sedimentation continues to the very close of the Cretaceous and the Tertiary sediments overlie either the Cretaceous or the Jurassic. Above the great Post-Jurassic unconformity ten new formations were discovered by our expedition and more or less clearly distinguished from each other by their vertebrate remains, according to the field determinations by Granger and Berkey. Four of these are in the Cretaceous, two at the confines of the Eocene and Oligocene, three in the Miocene, one in the Pliocene.

The only precedent to the magnitude and novelty of this reconnaissance in the geologic history of the arid regions of the world is to be found in the early surveys of our own western territories by Hayden as geologist-in-chief, Holmes as topographer and Leidy as vertebrate paleontologist.

SUMMARY OF FOURTEEN NEW FOSSIL-BEARING FORMATIONS DISCOVERED

Zones.

1. Pleistocene. An erosion epoch.

2. Pliocene. Cervus (Elaphus?) zone. Determined August 27, 1922.

2. Miocene. Not yet defined by determination of fossils.

2. Middle Miocene, Houldjin, Hsanda Gol, *Baluchitherium* zone, in two localities, *B. grangeri.* April 30, August 5, 1922.

1 Upper Eocene, Irdin Manha. *Protitanotherium zone. P. mongoliense,* April 27, 1922.=Uinta Beds of Utah.

1. Lower Eocene. Fossils not identified. September 14, 1922.

1. Upper Cretaceous. Iren Dabasu dinosaur beds.=?Ceratops, or Triceratops Beds of Montana. April 25, 1922.

2. Lower Cretaceous, Dja-doch-ta. Protoceratops zone. Ancestors of the Ceratopsia. September 2, 1922. No equivalent in N. America or Europe.

1. Jurassic. Plant remains.

1. Permian. Marine invertebrate remains. September 7, 1922.

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14 new life zones.

The geologic personnel of the expedition included Charles P. Berkey as chief geologist; Frederick K. Morris as geologist and topographer; Walter Granger as vertebrate palaeontologist. The entire personnel under Leader Andrews included a party of twenty-five—eight Americans, eight Chinese, nine Mongolians. By means of a train of seventy-five camels and two freight and three light automobiles, a three thousand mile reconnaissance was made between April 18 and September 20, 1922, when the party returned to Peking. The work was greatly aided by the Geological Survey of China, now under the management of Dr. V. K. Ting, honorary director, and Dr. W. H. Wong, acting director, with headquarters in Peking. On reaching the confines of Mongolia Berkey and Morris began a systematic and continuous route map and geologic cross section, which was carried throughout the whole itinerary. These studies early in the work determine the major structural and formational units and locate the major unconformities and other physical changes. The great Post-Jurassic unconformity, the Pre-Jurassic unconformity, the lesser Post-Cretaceous unconformity and the

Great Bathylithic Invasion were one after the other definitely distinguished.

The itinerary of the geologic party and series of discoveries are briefly stated by Professor Berkey as follows:

> Left Kalgan April 21. Went into camp at Iren Dabasu after finding rhinoceros jaw evening of April 24. First dinosaur bones found at Iren Dabasu morning of April 25 by Berkey before breakfast. Camp was divided April 25, leaving the geologic group, Morris, Granger and Berkey, at Iren Dabasu, giving special attention to the collecting of fossils. First finds of Titanotheres and other early Tertiary fossils by Granger at Irdin Manha April 27. Additional finds made at Irdin Manha by the geologic group May 2. First Baluchitherium bones found at Houldjin in the vicinity of Iren Dabasu, April 30, by Berkey. Geologic group stayed at Iren Dabasu until May 7. Basin later referred to as Tsagan Nor Basin was entered first at Mt. Uskuk June 21 by the whole party. First exploratory trip to Loh June 22 by the group, with recovery of a few fragments of bones. Discovery of dinosaur bones and fossil insects and fossil fish June 25 in the Ondai Sair locality by Berkey and Morris. Three great collections of Later Tertiary fossils judged to be of Miocene age made by Granger at Loh in the Hsanda Gol formation June 27-August 3. Discovery of Baluchitherium skull at Loh August 4 or 5 by Granger and Wong. Discovery of stag, mastodon, etc., judged to be of Pliocene age in the Hung Kureh district July 27 by Berkey. Whole group made collections later. Left the Tsagan Nor Basin August 13. Discovery of dinosaurs in the Ashile District by Granger August 20-27. Side trip to the Gurban Saikhan across a new basin by Morris and Berkey August 19-27. Discovery of Protoceratops by Shackelford at Dja-doch-ta September 2. Additional collections by the whole party. Discovery of Paleozoic strata with Permian fossils September 7 in the Sair Usu district by Berkey and Morris. Discovery of Ardyn Obo fossil-bearing beds September 10. Collections by the whole party. Discovery of Eocene forms in the sedimentary beds of Shara Murun by Granger and Andrews September 14. Discovery of fragments of bone in the sediments at the edge of the Mongolian plateau above Kalgan by Berkey September 19.

The first fossils brought back by Mr. Shackelford, photographer of the expedition, included the three great discoveries of the season, namely, (1) a superb *Baluchitherium* skull found east of the Altai Mountains, which is now being fully described by the writer; (2) a complete skull of *Protoceratops*, a pre-dentate dinosaur, ancestral to the giant Ceratopsia, just described by William K. Gregory; (3) jaw of *Protitanotherium*, which will shortly be described by the writer in *American Museum Novitates*. The main shipment of the Mongolian collection has just reached the American Museum and includes all the fossils collected on this very rapid reconnaissance. During the present season the same beds are being visited by a strong collecting party and already reports of additional discoveries of importance are reaching the museum.

HENRY FAIRFIELD OSBORN

SOME EXPERIMENTAL STUDIES ON THE CENTRAL NERVOUS SYSTEM[1]

ONE of the great contributions of the last century to the field of biological science was the application of experimental methods to the study of development, and the factors underlying the production of individual structure. Though many of the fundamental facts of embryology were known, the complexity of the factors which operate during the process of development was so great that further progress could be accomplished only by segregating or isolating certain structural units and by changing intrinsic and extrinsic relations to so modify the conditions of development that some tentative answers could be made to the question of causation in development.

One of the interesting problems in nervous embryology has been: What makes neuroblasts differentiate into neurones? and as a corollary to that, Why do neurones, whose cell bodies lie in a certain region, grow over a definite pathway and establish connections with another group of neurones so that they may become part of a complex chain of nervous units?

By experimental methods, Dr. Harrison has shown clearly that neuroblasts will develop into neurones when isolated from many of the normal environmental factors. Primitive nervous tissue from the central nervous system of the chick will grow in tissue cultures into apparently normal neurones. So long as the growing nerve cell is supplied with the necessary food, a certain amount of growth and differentiation will follow, without the presence of many of the normal conditions of development such as position with respect to other cell masses, hormones, chemical constituents of blood, of functional activity, etc. Just how complete this growth is, just how perfect a neurone is developed under such experimental conditions is of course questionable. But at least one fact was thereby established, namely that nervous tissue inherits a certain potential for differentiation which will result in a considerable degree of development of a cell even though isolated from its normal environment.

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[1] A paper read before the Tri-State Medical Society in New Haven, April 19, 1923.

Stimulated by Dr. Harrison, though using somewhat different methods and working with another form of animal, I have been engaged for the past few years in studying some of these problems. The larvæ of a small native salamander, Amblystoma, are peculiarly suitable for experimental work of this sort. They grow in quantity in the pools around New Haven, can be readily kept in the laboratory and can be operated upon before the development of the peripheral nerves, without asepsis. It is possible under laboratory conditions to remove or transplant portions of organ systems, to isolate organs such as the eye or nose, to interpose organs, an eye for an ear for example, to move organs from their normal position to some strange location, an ear on to the flank and so on. All these operations are performed before the development of the peripheral nerves and hence removes the disturbing factors of shock and pathological sequelæ.

The results of several years of such experimentation have shown a number of interesting things. If the primordium of the nasal apparatus be removed at an early stage, that part of the brain to which the olfactory nerve runs for a time develops normally, then as functional activity begins, it lags behind the hemisphere with undisturbed relations. This confirmed by experimental methods a theory of Roux that in the development of the nervous system two periods could be observed, the first one of growth and differentiation in which the primitive cells was transformed into a specialized neurone and the second one of pure growth during which the size of the neurone increased markedly, and its connections were more completely established. As a result, we find that the absence of an olfactory sac, and hence the olfactory nerve results in the retardation of the normal growth of the cerebral hemisphere, or in other words, when the olfactory nerve and sac are present, the hemisphere will grow to a greater size than when it is lacking. These results suggested the possibility of function as the stimulating factor in the second, or growth period, of nervous development.

In order to determine exactly whether or not this was so, a second series of operations were performed in which the entire cerebral hemisphere with the nasal apparatus attached, was transplanted back onto the trunk of Amblystoma larvæ. In a portion of these transplantations, the transplant was so placed that the olfactory placode healed in beneath the skin so that there was little possibility of its functioning. In the rest, the complex was placed with the olfactory sac at the surface so that it might conceivably function. The results of these operations showed that the stimulating factor for the second growth period was probably not functional activity but rather the stimulus afforded by the ingrowing olfactory nerve, since in both series the size of the hemisphere closely approximated the normal undisturbed hemisphere.

Questions that immediately arise are: How potent a factor is this stimulation which results from a nerve trunk or tract growing into a collection of nerve cells? Would it be great enough to bring about regeneration of such a mass and would the presence of a nerve trunk larger than normal produce an enlargement of such a mass of nerve cells?

To answer the first question a series of embryos were operated upon in which the cerebral hemisphere was removed, and the olfactory sac returned to its normal position. In the process of healing the inter-ventricular foramen left open by the removal of the hemisphere was closed in by a thin layer of cells derived from the ependymal lining of the neural tube. When the ingrowing olfactory nerve reached this new portion of the wall of the neural tube, the latter were stimulated to differentiate and develop into a complete new hemisphere, which in both structure and size was apparently a *completely normal* hemisphere. We can, therefore, answer the first question in the affirmative. A group of axones growing into a collection of primitive cells is able to cause them to regenerate a complete new part of the brain.

To determine the stimulating effect of a larger nerve trunk than usual on neuroblasts, an extra olfactory sac was transplanted beside the normal one in such a way that the ingrowing nerve trunk could establish connection with the hemisphere. Here, though, in some instances the olfactory nerve did not reach the cerebral hemisphere. In those cases in which it did, the hemisphere increased in size markedly over the normal hemisphere. The results obtained showed that the growth into the cerebral hemisphere of more axones from olfactory neurones than normal produces an enlargement of an embryonic nervous cell mass, since the hemispheres in such operated embryos eventually grew to be approximately 20 per cent. greater than normal.

The experiments show, then, that the removal of an end organ results in the failure to grow to full size of the part of the brain with which it is connected, that ingrowing fibers from such an end organ can stimulate the primitive ependymal lining of the neural tube to form a new portion of the brain and that a superabundance of such ingrowing nerve fibers can stimulate the normal brain to increase in size approximately 20 per cent.

To put it in another way, the above experiments show that nerve cells grow, first as a result of an inherited potential for differentiation, and secondly as a result of stimulus derived from the contact of telodendria from other neurones. This latter stimulus is, in Amblystoma, sufficiently strong to produce regeneration and hyperplasia of the cerebral hemispheres. Functional activity is not excluded as a factor since we do not yet know what occurs when neurones establish connections within the central nervous system. The exteroceptive phase of functional activity at least has little or no effect.

H. S. BURR

YALE UNIVERSITY SCHOOL OF MEDICINE
APRIL 19, 1923

THE MASKELL COLLECTION OF COCCIDÆ

WILLIAM MILES MASKELL was registrar of the University of New Zealand. He pursued the study of the Coccidæ when not busy with the arduous duties of his official position. His first paper was published in 1879. With the exception of four years, he published an annual illustrated memoir, 1879-1898, in the *Transactions* of the New Zealand Institute. In addition to the memoirs about twenty other papers were published. These included a very large number, several hundred, new genera and species. He had the advantage of being located in the midst of a marvelously rich coccid fauna.

Many of the species of Coccidæ have proved to be of economic importance. This has resulted in the discovery of many new forms. The description and study of these new forms has brought to light many characters either not figured or not described or noted by Maskell, so that his genera and species needed to be restudied in order to determine their correct affinities and to permit of their proper location in the classification of the family. The officials of the U. S. Bureau of Entomology were able through the assistance of Mr. T. W. Kirk of the New Zealand Department of Agriculture to borrow this collection, which reached Washington in 1909.

The remounting and study of the collection was begun immediately. The first results of these studies, thirteen years after the reception of the collection, have appeared and deal with the species of Maskell that have been made the types of genera by Maskell and others. This contribution is by Harold Morrison and Emily Morrison, printed in the *Proceedings* of the U. S. National Museum for 1922.

There is included a discussion of the species belonging to seven subfamilies, and thirty-seven genera and subgenera. The authors have attempted to describe each species so fully and to figure all parts so carefully that future workers would have no need to consult the original type-material. How successfully this has been done only time will show, for with the advancement of the classification of a group, each generation frequently uncovers characters not hitherto used, so that it is very difficult for the workers of one generation to unearth all the characters that will be used by succeeding generations. Long but concise carefully prepared descriptions covering all parts are given. These are amplified by the numerous figures of the insects as a whole and of their various parts in great detail. The figures of a species are grouped together and printed as text-figures. While it is always of importance to have a figure near the description for comparison, yet the effect and detail of figures printed upon plate-paper is so much better than those printed on ordinary print-paper that convenience should have been overlooked, particularly in a work of such value to future students of the Coccidæ as this one. Figures where one half shows the dorsal surface and the other half the ventral surface are being produced by many authors. This is to be deplored because such figures never give the perspective of the insect as a whole that can be secured from complete figures of each surface while there is always confusion and doubt as to the accuracy of the structures located on and near the meson, and so long as the government is financing the project, the question of expense should not be a serious one. This is particularly unfortunate in figures of the anal ring, a structure that is going to be used much more in the future than in the past, especially in the subfamily Eriococcinæ and its allies. The figures showing the anal ring are all on too small a scale or very indifferently done and do not bring out their pertinent characteristics. An admirable feature of this contribution is the attention given to other individuals than the adult female, the first nymphal stage and the adult male where available being described.

This is one of the very best studies of the Coccidæ made by an American in many years, regardless of my criticisms, and the authors are to be congratulated on starting this series of studies with such a thoroughgoing piece of work. It is to be hoped that they will follow the policy of Maskell and publish at least one large contribution each year until the study is completed. If our National Museum is to retain its supremacy so far as the Coccidæ are concerned it must be by contributions to their study and not by number of insects in cases.

ALEX. D. MACGILLIVRAY

UNIVERSITY OF ILLINOIS

SCIENTIFIC EVENTS

SHAD INVESTIGATIONS IN CONNECTICUT

AN investigation of the cause of the marked depletion of the Connecticut River shad is being undertaken by the Connecticut State Board of Fisheries and Game. The commercial catch of shad has decreased alarmingly since 1919. The number of eggs obtained for artificial propagation has also decreased during recent years. The work now in progress includes: (1) Experimentation with methods of catching shad for spawn taking, (2) a study of the feeding habits, periods of migration and other phases of the life history of the shad, (3) studies of the enemies of larval and young shad, of parasitism and of other phases of pathology, (4) a detailed study of ecological conditions, including pollution, of the tributaries of the Connecticut in which shad are known to spawn, and (5) tagging of adult shad in an attempt to follow successive migrations. Another experiment is designed to test the possibility of furnishing comparative security to young shad by retaining a part of the product of the hatchery in specially prepared ponds freed from other fish.

The staff engaged in this work includes: Mr. J. W. Titcomb, superintendent of the fisheries and game of Connecticut; Dr. P. H. Mitchell, of Brown University, director of the investigations; Dr. Emmeline Moore, who is enabled to undertake this work through the courtesy and cooperation of the New York State Conservation Commission of which she is biologist; Dr. J. E. Blair, of Leland Stanford University; Mr. H. E. Gallup and Mr. F. B. Littlefield, of Harvard Medical School.

The Connecticut legislature has appropriated $10,000 for this work. The investigations will be continued through the summers of 1923 and 1924.

PASTEUR CELEBRATIONS IN FRANCE

THE official French celebration of the centenary of Pasteur began in Paris on May 24. According to an article in the *British Medical Journal* many delegates from universities and institutions throughout the world attended a reception given by the president of the French Republic. On the following morning the delegates were welcomed by Dr. Roux at the Pasteur Institute; a bust of Pasteur erected in the gardens of the institute was unveiled and wreaths laid at its foot by foreign delegates, who afterwards visited the museum and the crypt, where is the tomb of Pasteur. Later in the day there was a great meeting in the amphitheater of the Sorbonne, presided over by the president of the republic, who was accompanied by the ministers, by members of the diplomatic corps, by members of the five academies of the Institut de France and the Académie de Médecine and by foreign delegates to the number, it is said, of some seven hundred. The proceedings began with the unveiling by M. Paul Appell, Rector of the University of Paris, of a marble tablet placed by the university in the Salle des Autorités, bearing an inscription stating that it has been erected on the spot where "le grand Français et le grand Anglais Lister se sont embrassés" to commemorate "cette étreinte fraternelle, symbole de l'amitié de deux peuples." Afterwards the Marquess of Crewe, British ambassador in Paris, expressed the deep appreciation of this homage to Lister paid in the heart of the intellect of France. The popular celebration took place on Sunday, which was a flag day in Paris and the chief towns of France, and badges were sold for the benefit of the laboratories of France. In the afternoon the delegates attended a reception given by the City of Paris at the Hôtel de Ville. On Monday a visit was paid to Versailles, when a bust of Pasteur given by his daughter and son-in-law, Mme. and M. Vallery-Radot, was unveiled in the Galerie de Glaces. The president of the Republic during the previous week started on a tour, during the course of which he took part in celebrations at Arbois and Strasbourg.

IN HONOR OF PROFESSOR MORSE

From an article in the *Boston Transcript* we learn that to celebrate the eighty-fifth birthday of Professor Edward S. Morse of Salem, twenty members of the Boston Malacological Club visited him in his laboratory at the Peabody Museum in Salem, on June 18, to congratulate him and wish him years of useful work in the future. The visitors were headed by President Arthur F. Gray, of Watertown, who at an appropriate moment presented Dr. Morse with a silver pitcher and tray, the former suitably inscribed, giving at the same time a short review of some of Professor Morse's special researches. "Since 1856 this active scientific man has been busy with many lines of scientific and artistic work, never forgetting his first deep interest, the shells of which he described a new species while merely a boy. His splendid labors in Japan, where he was one of the famous group of teachers who laid the firm foundations of education in that country, were touched upon with a sketch of the later researches largely in connection with the Peabody Academy in Salem."

Following a basket luncheon, the company adjourned to the home of Professor Morse, where the afternoon was spent in looking over his treasures, including two splendid decorations from the emperor of Japan, autographed volumes, models of the skull of early man, shell studies and a host of special items. Not the least interesting feature was a stroll with Professor Morse through the Weld Hall of Japanese curiosities, where he gave the company special descriptions of many of the things there shown, noting in places how they had been secured.

Present in the company were three of the original nature class given in Salem in the year following the celebrated start of the idea by Professor Agassiz, namely, J. H. Blake, student under Agassiz and artist for his expeditions; James H. Emerton, authority on spiders, and Arthur F. Gray, who acquired collections and books of Binney, a great conchologist of Massachusetts.

THE DIRECTORSHIP OF THE MOUNT WILSON OBSERVATORY

Because of persistent ill health, which has greatly reduced his working capacity during the last fifteen years and repeatedly threatened the necessity of complete retirement, Dr. George Ellery Hale has felt compelled to request of the Carnegie Institution of Washington a material reduction of his responsibilities as director of the Mount Wilson Observatory. On the recommendation of President Merriam, the executive committee of the institution has adopted a resolution appointing Dr. Hale honorary director of the Mount Wilson Observatory, with the understanding that he will remain in charge of its general policy and continue to give special attention to the development of new methods and the attack upon new problems. On July 1, when the new arrangement goes into effect, Dr. Walter Sidney Adams, who has had long and successful experience as assistant director of the observatory and also as acting director during Dr. Hale's absence, will become director of the observatory in charge of operations. Dr. Hale's purpose in requesting relief is to find a means of accomplishing in the future the greatest possible amount of scientific work that his health will permit. He is still in Europe, but hopes to be able to return to Pasadena in October.

SCIENTIFIC NOTES AND NEWS

At a meeting of the council of the University of Strasbourg held on May 24, the honorary degree of doctor of the University of Strasbourg was conferred upon Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research.

At the commencement exercises of Yale University the doctorate of science was conferred on Dr. Walter B. Cannon, professor of physiology in the Harvard Medical School; Dr. Jacques Loeb, of the Rockefeller Institute for Medical Research; Dr. Henry F. Osborn, president of the American Museum of Natural History; the degree of master of arts was awarded to Joseph H. Pratt, state geologist of North Carolina.

Princeton University has conferred the doctorate of science on Dr. Theodore William Richards, Erving professor of chemistry and director of the Wolcott Gibbs Memorial Laboratory at Harvard University; and on General John Joseph Carty, of New York City, chief engineer and vice-president of the American Telephone and Telegraph Company.

At Harvard University, the doctorate of laws was conferred on Dr. Samuel W. Stratton, president of the Massachusetts Institute of Technology.

At the commencement of Wesleyan University the doctorate of laws was conferred on Dr. James Rowland Angell, president of Yale University, and the doctorate of science on Dr. Robert M. Yerkes, of the National Research Council.

Dr. A. H. Gill, professor of technical chemical analysis at the Massachusetts Institute of Technology, received the honorary degree of doctor of science from the Rhode Island State College at its thirtieth annual commencement. The degree of master of science was conferred on Robert H. Smith, assistant professor of machine construction at the institute.

Dr. H. A. Lorentz, professor of physics in the University of Leyden, who has been lecturing in England, was the guest of the Anglo-Batavian Society at a dinner given in London on June 6. Following the speech of Professor Lorentz, responses for other guests were made by Lord Haldane and Professor G. N. Lewis, of the University of California.

Sir William Bragg has been elected to be Fullerian professor of chemistry at the Royal Institution and director of the laboratory and of the Davy Faraday Research Laboratory, in succession to Sir James Dewar.

Dr. D. Roberts Harper 3d, physicist of the National Bureau of Standards, has been detailed to New York for service as liaison officer between the Bureau of Standards and the American Engineering Standards Committee in the Engineering Societies Building, succeeding Dr. A. S. McAllister, of the Bureau of Standards, recalled from New York to Washington. Dr. McAllister takes charge of part of Secretary Hoover's special work in relation to commodity standards and specifications, inaugurated recently under the Bureau of Standards.

The department of entomology of the University of California, and the staff of the museum of the California Academy of Sciences gave a complimentary dinner at the Hotel Stewart, San Francisco, on June 2, to Professor and Mrs. T. D. A. Cockerell, who were passing through San Francisco on their way to Siberia. Thirty-six were at the table, including many of the leading biological workers of the Bay Region of California. Dr. Barton W. Evermann acted as toastmaster. All present joined in wishing their guests a pleasant voyage and abundant success in their quest for fossil insects.

DR. HARRY R. SLACK, JR., associate in laryngology in the Johns Hopkins Medical School, who has been exchange professor in Peking Union Medical College for the past year, sailed on June 20 from Shanghai. Dr. Slack will spend some time in the clinics of Vienna and Paris before returning to America about October 1.

DR. ADOLPH MEYER, psychiatrist-in-chief of the Johns Hopkins Hospital, has gone to Europe to visit his old home in Zurich, Switzerland, and to inspect psychiatric clinics in England, France and other European countries.

ON May 17 Professor Edward L. Nichols, of Cornell University, lectured before the students of Wellesley College on "Science in the colleges."

DR. EDGAR FAHS SMITH, lately provost of the University of Pennsylvania, delivered the commencement address at the University of Arkansas on June 12. While in Fayetteville he addressed the Arkansas Section of the American Chemical Society, and was guest of honor at a luncheon given by the section.

DR. ARTHUR LACHMAN, research associate at the University of California, spoke on "The present status of organic chemistry" at Northwestern University on May 10, and at the University of Chicago on May 17.

ON Monday evening, June 11, resident members of Sigma Xi and other men interested in scientific research at the State College of Washington, met at a dinner with Dean Edward Ellery, national secretary of Sigma Xi. In the afternoon of the same day, Dean Ellery delivered a lecture on "The structure of the atom," illustrated by the film prepared in the research laboratory of the General Electric Company, and the following morning gave the annual Phi Kappa Phi address on "The rôle of science in the spiritual evolution of man."

PROFESSOR C. MOUREU, president of the Chemical Society of France, gave a lecture on "Les gaz rares des sources thermales, des grisous et autres gaz naturels" at the rooms of the Chemical Society, Burlington House, on June 14.

JOSEPH KEELE, a member of the staff of the Geological Survey of Canada, died on June 11. Mr. Keele spent the earlier years of his connection with the survey in making geological explorations in Yukon and Northwest Territories. He is better known for his work on clays and shales of Canada in their application to the ceramic industries.

DR. G. H. HUME, for many years lecturer on physiology in the University of Durham College of Medicine, died on May 8, aged seventy-seven.

MR. WILLIAM HENRY PEARSON, of Manchester, England, well known for his studies in Canadian and tropical Hepaticae, died recently of pneumonia in his seventy-fourth year.

JOSEPH WRIGHT, the Irish naturalist, died on April 7 at the age of eighty-nine years.

THE *Journal* of the American Medical Association states that a Portuguese merchant who had amassed a fortune in Brazil and returned to Lisbon to live, recently bequeathed his fortune to found an institute for scientific research, naming Professor Ferreira da Mira as the one to have charge of the institution. No specifications as to site, scope or other details were made and no scientists knew of the provisions of the will in advance. As Professor Ferreira de Mira had no personal acquaintance with the testator, and as he is the incumbent of the chair of biology, the council that was organized by the state for the creation of the institute decided that Lisbon should be the location and the biologic sciences the field of the Bento da Rocha Cabral Institute for Scientific Research.

THE Australian Institute of Tropical Medicine was opened at Townsville in 1913, in the part of the great continent that lies within the tropics, with Dr. Anton Breinl as the first director. He resigned in 1921, and the institute became dormant. We learn from the *Journal* of the American Medical Association that, with the creation of the commonwealth department of health, the institute has been reconstructed. Its activities include the establishment of laboratories to render assistance to physicians in bacteriologic, protozoological and biologic work, and the organization of a service to deal with tropical diseases in Australia and her dependencies. Work on hookworm disease has been done with the assistance of the Rockefeller Foundation. The whole of Australia and her dependencies have been surveyed, and the distribution of hookworm disease has been determined. It is proposed to establish permanent measures of control and thus to eradicate the disease. By arrangement with the Rockefeller Foundation, a section of the work will be carried out with the collaboration of the Australian Institute of Tropical Medicine. Also, an inquiry into the incidence of malaria and filariasis has been begun. The staff is being reappointed, and Dr. R. W. Cliento, a recent graduate of Adelaide University, has been appointed director. He has been sent on a tour to Java, Ceylon, India, Italy, England, the United States and the Panama Zone to study the methods of control of tropical diseases. Arrangements have been made with the Universities of Melbourne and Sydney for the instruction in tropical medicine required for a diploma.

THE British Medical Research Council announces officially that insulin, the new treatment for diabetes which was discovered at Toronto by Dr. Banting, and which is an extract of the island tissue of the pancreas, is now being "used in treatment for the relief of patients selected for the purpose at each of the following hospitals: In London, at St. Bartholomew's, Guy's, St. Thomas's, the London and University College; in Sheffield, at the University Departments of Pharmacology and Physiology and at the Royal Infirmary; in Edinburgh, at the Royal Infirmary." Arrangements are in progress for extending this work to other hospitals and institutions "where the necessary conditions both personal and material can be provided. Every effort is being made to increase the supply of insulin, so that it may be available for use in general practice." The following official announcement has been made public: "The council are able to say that the progress towards successful large-scale production has been more rapid than they had ventured last November to hope. . . . Subject to limitations of raw material in particular districts, successful manufacture is now (they believe) assured; but a period of some weeks must pass before laboratory tests and clinical use under special safeguards will have made it justifiable for a supply to be issued generally for routine use under the ordinary conditions of medical practice."

THE British National Poultry Council announces that the Ministry of Agriculture intends to proceed without further delay with those parts of the institute scheme that have to do with research in connection with breeding, disease and nutrition. These sections do not require so much preparation as the other parts of the scheme, and it is anticipated that, as £5,000 of the required contribution from the industry has been secured, the balance of £1,500 will be forthcoming shortly, thus rendering available the whole of the £50,000 grant from the special fund sanctioned in 1921.

SHORTLY before the war the Marquise Arconati-Visconti gave two million francs (then £80,000) for the erection in Paris of an institute for the study of the history of art and of archeology. The work was, however, suspended by the war and the high cost of materials four years later prohibited its resumption. In her will the Marquise provided that for four consecutive years a sum of 250,000 francs (about £3,500 at the present rate of exchange) be drawn from the revenues of her estate and devoted to the construction of the institute, which is to be erected in the Avenue de l'Observatoire.

THE cinema film taken in Australia in connection with the total solar eclipse of the sun at Wallal last September was shown at the Royal Albert Hall, London, on May 12 and following weeks. *The Observatory* writes: "Besides the actual eclipse with pictures of the corona, the film covers the experiences of the different eclipse expeditions (American, Australian, Canadian, English and Indian) from the time of their arrival in Australia to the time of their leaving. The American expedition, for example, is traced from Adelaide. The difficulties of transportation at Broome and of landing at Ninety-mile Beach, where there is a very large range in the tides and a heavy surf, are shown. The camp-life of the astronomers and the nature of the country at Wallal should also prove of interest. The part of the film dealing with the few minutes of totality will, of course, be run through in as many minutes, but the whole film, which should prove of general geographical and educational, as well as of astronomical, interest, will occupy an hour or a little more. The eclipse film will be screened along with other films showing life in Australia.

The Hancock Life Insurance Company, Boston, has made an additional gift of $20,000 to the Harvard Cancer Commission; $5,000 to be used for purchase and installation of a diagnostic apparatus and $15,000 to be placed in the permanent fund. The insurance company previously gave $30,000 toward the building of the Huntington Hospital, which is devoted exclusively to cancer cases. The new gift will be used in the biophysical laboratory, which is also under the direction of the commission.

UNIVERSITY AND EDUCATIONAL NOTES

At the commencement exercises of Harvard University President Lowell announced the receipt of gifts during the year amounting to nearly four million dollars. This sum includes the payment of pledges to the Harvard endowment of $1,080,619.

The Tanners' Council of America has voted to erect a research laboratory at the University of Cincinnati, contributing $110,000 for the erection of the building.

Two bequests, one of £30,000 and one of £20,000, have been made to the University of Melbourne Medical School.

Dr. Frederick P. Gay, professor of bacteriology in the University of California, has accepted the chair of bacteriology in Columbia University.

Professor M. C. Burritt and Professor W. H. Chandler, vice-deans of the New York State College of Agriculture, will retire at the end of the present academic year.

DISCUSSION AND CORRESPONDENCE

THE PREPARATION OF FIVE KILOGRAMS OF DESICCATED EUGLENA[1]

Gottlieb (1850), Kutscher (1898), Bütschli (1906) and others have attempted the collection of *Euglena* in amounts sufficient to warrant biochemical investigation of this relatively accessible microorganism. Their interesting results were in each case limited by the very small quantity of material attained by their methods of filtration and sedimentation. The present communication is offered as a suggestion that *Euglena*, and possibly other unicellular bodies, can be obtained in great quantities with less difficulty than might at first be apparent.

In 1921 a heavy scum, or "bloom" of *Euglena* (Sp.) appeared on one of the campus ponds. To concentrate this scum by filtration is impracticable. It was found, however, that the scum is sufficiently tenacious to permit its accumulation with the following device. By means of cords, a wooden float, consisting of a board 1.5 m. long, 10 c.m. wide and 5 c.m. thick, was suspended parallel to and from the small end of a long bamboo pole. To collect the material the pole was swung in arcs over the surface, dragging, or better, pushing, the scum close to a concrete embankment—an effect suggesting the skimming of cream with a gigantic spoon. The scum was then easily gathered with a large photographic developing tray and transferred in five or ten gallon lots to the laboratory.

After sufficient dilution, the euglenae were shaken until a uniform suspension resulted. This was strained through a "10-mesh" brass sieve to remove the gross débris. The fluid was then forced through a "60-mesh" sieve by stroking the upper surface of the sieve with a strip of pliant rubber. The suspension was allowed to stand in the dark for twelve hours in large jars to which cracked ice had been added. It was found that agitation followed by cold and darkness results in the euglenae settling sharply as a bottom sludge. The supernatant liquid, containing most of the foreign protozoa and some other floating particles, was siphoned off. Microscopic examination revealed that the sludge consisted of euglenae in a state of high purity.

The sludge was dehydrated by adding an equal volume of ninety-five per cent. alcohol, allowing the euglenae to settle, decanting the diluted alcohol and adding fresh; this procedure being repeated until the euglenae were in ninety per cent. alcohol. After a Buchner filtration, the filter-cake was granulated with a potato masher. The resulting damp granules were dried at 50°. From roughly 250 liters of scum five kilograms of euglenae were obtained as a non-hygroscopic, dusty, gray-green, granular powder.

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[1] 1850 Gottlieb, J. *Ann. d. Chemie u. Pharmacie* Bd 75 p. 51; 1898 Kutscher, F. *Zeitschr. f. physiol. Chemie* Bd. 24 p. 360; 1906 Bütschli, O. *Arch. f. Protisten.* Bd. 7 p. 197.

CHARLES E. BILLS
ZOOLOGICAL LABORATORY
THE JOHNS HOPKINS UNIVERSITY

SYRPHID LARVÆ AS PESTS

WE are all accustomed to regard the predacious larvae of several of our syrphid flies as distinctly beneficial insects. It was, therefore, a great surprise to learn, a few days ago, that the larvae of some of these flies were the cause of the closing of several canneries in the Santa Clara Valley, California.

During the past few years the business of canning spinach has grown until it is now an industry of considerable importance in California. Hundreds of acres are sown to this crop, the grower receiving about $20 a ton for the spinach cut and crated in the field. The average yield is four to six tons per acre.

Soon after the spinach began to come into the canneries this spring it was noticed that there was an unusual number of "worms" on the leaves and that many of these were not removed in the usual washing process and that some of them even found their way to the cans that were ready for sealing. The cannery men immediately stopped canning and sent word to the growers that no spinach infested with the "worms" would be received. This meant the loss of hundreds of thousands of dollars to the growers as well as tremendous losses to the cannery men who had already contracted to deliver what they had every reason to believe would be the largest output in their history.

An investigation showed that the principal cause of all this trouble was the larvae of one of our most common syrphid flies *(Lasiophthicus pyrastri)* which were feeding on the aphid *(Rhopalosiphum persicae)* which is a common pest of the spinach. The larvae of other syrphid flies were present also, but this *L. pyrastri* was the most common. The season had been a particularly favorable one for the flies and we found that the larvae were doing a remarkable work in destroying the aphids. But as some of them would stick to the leaves even through the washing process and turn white when the spinach was in the scalding water, their presence on the leaves when it was ready for the can was easily detected and, of course, the product could not be used.

A few days later the number of larvae to be found on the spinach in the field began to decrease very rapidly and at the end of a week they were so scarce that some of the cannery men decided to see whether by using particular care in picking over the spinach in the cannery they could not get a clean product. Even the most careful work, however, failed to dislodge all of the larvae and it was decided not to pack any more spinach this season, as the cannery men are determined that the pack that goes out from their places shall be perfectly clean. This means that the growers in this valley will lose approximately $400,000 because of the presence of this "friendly" insect in their fields.

Spinach that is planted early in the fall and is ready for the cannery in March is not infested by the aphids to any extent and the syrphid larvae are not to be found until the aphids are there. Early planting, then, is the remedy.

R. W. DOANE
STANFORD UNIVERSITY
APRIL 23, 1923

ON THE VITALITY OF COTTON SEED

AMONG our most destructive cotton diseases is anthracnose which is caused by the fungus *Colletotrichum Gossypii Southw.* So widespread and destructive is this disease in the cotton growing states that its literature is now quite extensive. In common with other members of the genus, the fungus infects the seed and in this way is carried over from one season to the next. It is, therefore, necessary in order to combat the disease effectively to secure uninfected seed for planting.

Treating the seed with fungicides has been tried with negative results. The difficulty encountered was the inability of the disinfectant to penetrate the seedcoats and so reach the fungus. The hot water method of treating seed was also tried and promised well but was later abandoned as unpracticable. The thermal death point of the fungus appeared to be too near that of the seed. From the results of previous work it appears that the ordinary method of seed treatment will give unsatisfactory results.

It is generally thought that the thermo death point of cotton seed is about 80°C., but the writer finds that the temperature which cotton seed can endure without affecting the vitality of the seed depends upon several factors. First, the amount of moisture present in the seed; second, whether heated in dry or moist atmosphere; third and perhaps the most important, whether there is oxygen present during the process of heating. If cotton seed containing a normal amount of moisture are placed in water at 70° to 80° C. the life of the seed will be destroyed. On the other hand if the cotton seed are thoroughly dried at low temperature, they can then be heated for ten to fifteen minutes at 100° C. in a dry atmosphere without affecting the vitality. But this treatment destroyed only a small percentage of the fungus. We have found that by thoroughly drying and heating cotton seed in a vacuum or any inert atmosphere, such as nitrogen, to prevent oxidation of the fats and proteins in the seed they will endure the temperature of boiling water for hours without affecting their vitality.

In fact we have heated the seed of Weber 49 variety of cotton for 26 hours without impairing their vitality and by this treatment have completely destroyed the fungous anthracnose. The seed so treated have a much higher percentage of germination than the untreated seed. Very highly infected seed of the Weber 49 variety were used in all our experiments. We are applying our method of treatment to other varieties of cotton seed and diseases carried by seed of other crops.

G. F. Lipscomb
G. L. Corley
University of South Carolina

MISUSE OF THE WORD "CREATION" BY NATURALISTS

The word *creation* is sometimes used by naturalists in a sense that is not only inaccurate but which, even from the standpoint of the author's own belief, is actually misleading. I refer to its application *to the mode of origin* of animals or plants in a state of nature.

Such use of the word is objectionable for two reasons: (1) It implies a sudden coming into existence, ignoring ancestry; (2) it implies the act of a superior power, for how can there be a *creation* without a *creator?*

The proper meaning of the word as defined by leading lexicographers would seem to be free from ambiguity. Webster's definition is, "To bring into being; to cause to exist, said especially of the divine fiat by which the world is regarded as brought into being out of nothing." Similarly, the Century Dictionary definition is, "To bring into being; cause to exist; specifically to produce without the prior existence of the material used, or of other things like the thing produced; produce out of nothing." Both authorities take their first example from the Bible:

> In the beginning God created the heaven and the earth.

In reference to the origin of living organisms, does it not go without saying that the words *creation* and *development* (or *evolution*) convey diametrically opposite meanings—the one implying a sudden origin independent of ancestry; the other a gradual development from an antecedent form? Then why should one use *creation* when he means *development* or *evolution?*

In connection with the phantom of creation it may not be amiss to mention that the Mosaic conception of the origin of man as a definite act of a creator finds a close parallel in the beliefs of certain of our North American Indians. Thus, a California tribe holds that man was created by three deities—the Coyote, the Bear and the Lizard. Coyote wanted man to be fashioned after himself; Lizard objected, insisting that man should have five fingers like himself, so that he could take hold of things; while Bear maintained that man should have large flat hind feet in order that he might stand erect. So they compromised, Bear giving man his hind feet, Lizard his five fingers, Coyote his mental alertness.

This, like the Mosaic conception, pictures man as the result of a definite and deliberate act of creation. The circumstance that the Mosaic belief is monotheistic, the Indian belief polytheistic, is of no consequence from the standpoint of man's origin, both agreeing that he was created out of raw materials by a preexisting deity or deities.

C. Hart Merriam

STANDARDIZED NOMENCLATURE OF BIOLOGICAL STAINS

At a meeting of manufacturers and dealers in biological stains in September, 1922, the committee in charge of the investigation of stains was asked to draw up a standardized list of the most commonly used stains indicating in each case both the preferred designation and the most commonly used synonyms. Such a list has now been prepared with the cooperation of the manufacturers and others interested in these stains. This list is hereby published as a step toward stabilizing the nomenclature of these products.

The list as given here is divided into two groups: first the stains which might be called staples and which are necessary in practically all biological laboratories; and secondly the less commonly used stains which are required only for special purposes. Manufacturers and dealers assure us that the bulk of the business is done with the stains on the first of these two lists.

The accompanying list of stains is not claimed to be anywhere near complete. There are many dyes sometimes used as stains for special purposes that are not included because

LIST OF ORDINARY STAINS

I. STAPLES

(a) *Synthetic dyes*

Schultz No.	Preferred Designation	Synonyms; and slightly varying shades
38	Orange G	Patent orange. Crystal orange. Wool orange. (Slightly differing grade: Orange GG, GMP)
124	Janus green B	Diazin green.
223	Sudan III	Scarlet G or B. Fettponceau G. Oil red. Cerasin red.
307	Congo red	Congo. Cotton red. Direct red. Cosmos red.
511-3*	Fuchsin, basic	Fuchsin. Diamond fuchsin. Magenta. Rubin. Rosanilin. Rosanilin hydrochloride. (Different grades sold under the name of fuchsin followed by various shade designations).
515	Methyl violet 2B	Methyl violet. Dahlia B. Paris violet. Gentian violet. Pyoktanin blue. (Slightly differing grades: Methyl violet B, BBN, BO and V3).
516	Crystal violet	Violet C, G or 7B. Gentian violet. Hexamethyl violet.
......	Gentian violet†	
519	Methyl green	Double green. Light green.
524	Fuchsin, acid	Fuchsin S, SN, SS, ST or S III. Acid magenta. Acid rubin.
539	Anilin blue, water soluble	China blue. Soluble blue. Marine blue. Blackley blue. Cotton blue. Water blue. Berlin blue.
568	Pyronin	
587	Eosin, yellowish	Eosin. Water soluble eosin. Eosin Y, W or WS. (Various grades denoted as Eosin G, Y extra, S extra, J extra, B extra, GGF, 3J, 4J, KS, DH and JJF.
659	Methylene blue, Med., U.S.P.	Swiss blue. (Slightly different grades: Methylen blue BX, B, BG and BB).
670	Neutral red	Toluylene red.
679	Safranin O	Safranin AG, T, MP, Y and G.

(b) *Natural dyes*

Schultz No.	Preferred Designation	Synonyms; and slightly varying shades
982	Cochineal	(The aqueous extract of the cochineal insect).
	Carmine	(The lake prepared by adding alum to cochineal).
	Carminic acid	(The active dye purified from cochineal).
988	Hæmatoxylin	(The ether extract of logwood).
	Hæmatein	(The dye formed on oxidation of hæmatoxylin).

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* Apparently three different dyes, corresponding to Schultz numbers 511, 512 and 513, are sold as basic fuchsin. It is apparently the case that a different product is required as an indicator in the Endo medium from that required for staining; but conflicting statements have been received, and the matter needs investigation.

† Nearly synonymous with methyl violet; various mixtures of methyl and crystal violets sold under this name, generally with a high percentage of dextrin.

the call for them is small, although in some cases new developments in technic may cause a growing demand for them in the future. For this reason manufacturers and dealers in stains are not asked to list no other stains in their catalogs; but it is hoped that so far as their catalogs include the stains given in the accompanying list they will use the nomenclature here recommended. It is suggested that they use the two lists given here, with the Schultz number and as many synonyms as they care to employ and then as a supplementary list those stains which they have in stock but which are not included in this list.

In explanation of this list it must be remarked that wherever possible only one shade of any particular stain has been listed and the closely related shades are mentioned in the column of the table indicated for that purpose. This is done because in most cases it proves that only one or two of the various shades are of any special use as biological stains. It should further be explained that the Schultz number given in the first column refers to the fifth edition of Schultz's *Farbstofftabellen* published in 1920, except in the case of the last few stains in the table, which were listed in earlier editions of this publication but not in

II. LESS COMMONLY USED STAINS

Schultz No.	Preferred Designation	Synonyms; and slightly varying shades
4	Naphthol green	
6	Martius yellow	Naphthol yellow. Naphthalene yellow. Manchester yellow.
33	Chrysoidin Y	Chrysoidin. Brown salt R. Dark brown salt R. (Slightly different shades: Chrysoidin A, G, 2G, R, J, RE, JEE).
34	Chrysoidin R	Chrysoidin. Cotton orange. Cerotin orange. (Slightly different shades: Chrysoidin REE, RG).
112	Bordeaux red	True red B, P. Cerasin. Archelline 2B. Azo-bordeaux. (Various grades denoted as: Bordeaux B, BL, G, R extra).
138	Methyl orange	Orange III. Helianthin. Gold orange.
139	Orange IV	Orange N. Acid gold D. Tropæolin OO. Citronin V.
144	Orange I	Naphthol orange. Orange S. Tropæolin G, OOO No. 1.
145	Orange II	Gold orange. Orange A, P, G, R. Acid orange. Orange extra. Mandarin G. Tropæolin OOO No. 2.
168	Amaranth	Naphthol red. True red. Bordeaux. Bordeaux SF. Victoria rubin. Azo rubin. Wool red.
232	Sudan IV	Scarlet red. Fettponceau. Ponceau 3B.
247	Biebrich scarlet, water soluble	Ponceau B. Double scarlet. Scarlet EC.
283	Bismarck brown Y	Bismarck brown. Vesuvin. Phenylene brown. Manchester brown. Excelsior brown. Leather brown. (Slightly different shade: Bismarck brown G).
359	Trypan red	
363	Benzopurpin 4B	Cotton red. Dianil red. Diamin red. Sultan 4B. Direct red 4B.
391	Trypan blue	Diamin blue. Benzo blue. Dianil blue. Congo blue. Naphthamine blue. Benzamin blue. Azidin blue. Niagara blue.
493	Auramin	Pyoktaninum aureum. Pyoktanin yellow.
495	Malachite green	Emerald green. New Victoria green. Diamond green. Solid green. True green. New green. Light green N.
499	Brilliant green	Ethyl green. Solid green. Benzaldehyde green. Malachite green G.
505	Light green SF, *yellowish*	Light green 2G, 3G, 4G, 2GN. Acid green D, G, 5G, H, F, GB, GG, G extra, GW, OOO, O yellowish.
514	Hoffman violet	Dahlia. Iodine violet. Primula R. Red violet. Violet, R, RR, 4RN.
521	Spirit blue	Anilin blue, alcohol soluble. Gentian blue. Night blue. Lyons blue. Paris blue.
536	Alkali blue	
538	Methyl blue	Cotton blue. Wool blue. Helvetia blue.
555	Rosolic acid	Aurin.
555	Corallin, yellow	Sodium salt of rosolic acid.

the fifth edition. In such cases as this both the edition and the list number in that edition are given.

The list as it now stands is to be regarded as a preliminary one, subject to modification. In spite of all the advice received in preparing it, there are probably points in it still that are not correct. It is also obvious that the choice of preferred designation and the placing of any stain in either the first or the second list was more or less arbitrary and had to be a compromise between the various opinions re-

Schultz No.	Preferred Designation	Synonyms; and slightly varying shades
573	Rhodamin B	Rhodamin O. Brilliant rose.
585	Fluorescein, U. S. P.	Uranin.
588	Eosin, alc. sol.	
590	Eosin, bluish	Eosin BN, B, BW, DHV. Methyl eosin. Safrosin. Eosin scarlet B, BB. Scarlet J, JJ, V. Nopalin G. Cæsar red.
592	Erythrosin, bluish	Erythrosin B. Pyrosin B. Eosin J. Iodo-eosin. Dianthine B. (Slightly different shades: Erythrosin D, J, JNV, W).
597	Rose bengal	(Various grades denoted as: Rose bengal B, 2B, 3B).
621	Brilliant cresyl blue	Cresyl blue. Cresyl blue 2RN or 2BS.
653	Nile blue sulfate	Nile blue A.
694	Magdala red	Naphthalene red. Naphthylamine red.
697	Indulin, alc. sol.	Acetin blue. Azin blue. Solid blue.
698	Nigrosin, alc. sol.	Nigrosin B, BB.
699	Indulin, water sol.	(Various grades denoted: Indulin NN, N, N6, B, L, etc.).
700	Nigrosin, water sol.	Anilin gray. Steel gray. Indulin black. Gray R, B, BB. (Various grades denoted: Nigrosin DW, R, G, etc.).
777	Chromogen I	
788	Alizarin	(Various grades denoted as: Alizarin P, VI, Ie).
780	Alizarin red S.	Alizarin monosulphonate of sodium. Alizarin red WS. Alizarin carmine.
877	Indigo carmine	Indigotine.
934	Orcein	
I 276*	Lacmoid	Resorcin blue.
II 348	Thionin	Lauth's violet. (*Not* thionin blue, which is Schultz No. 661).
II 284	Iodine green	
IV 592	Toluidine blue O	
......	Azur I†	Methylene azur.
......	Azur II†	
......	Methylen violet, Bernthesen	(*Not* methylen violet RRA or 3RA, Schultz No. 680).
......	Cresyl violet	Cresyl echt violet.

* The Schultz number refers ordinarily to the 5th edition of Schultz' Farbstofftabellen. When the number is preceded by a Roman numeral, the dye in question is not listed in the 5th edition and the Roman numeral indicates the edition in which it is to be found.

† See U. S. Pharmacopœia, 9th Edition, p. 525.

III. COMPOUND STAINS*

Name	Reference
Azur-II-eosin	U. S. Pharmacopœia, 9th Edition, p. 525.
Balch's blood stain	Stitt, Practical Bacteriology, 6th Edition, p. 261.
Biondi-Ehrlich-Heidenhain triple mixture	Lee, Microstomists Vade-Mecum, 8th Edition, p. 173.
Ehrlich's triacid or triple mixture	Stitt, 6th Edition, p. 260.
Jenner's stain	Lancet, 1899, p. 370.
Leishman's blood stain	Stitt, 6th Edition, p. 261.
Tetrachrome blood stain (MacNeal)	Zinnser, Bacteriology, 4th Edition, p. 797.
Pappenheim's stain	Stitt, 6th Edition, p. 54.
Pappenheim's panoptic triacid stain	Lee, 8th Edition, p. 383.
Wright's blood stain	Mallory and Wright, Pathological Technic, 5th Edition, p. 364.

* The compound stains listed here are those which are commonly sold already compounded by manufacturers and dealers in stains, either in dry or in liquid form.

ceived. The future may show the desirability of changing some of these matters. Any suggestions along this line by readers of this article will be gratefully received.

It is hoped that both those who use and those who manufacture or handle biological stains will cooperate in this standardization, the latter by using the nomenclature in their catalogs and price-lists and the former by ordering stains by the names given here, specifying the Schultz number whenever one is listed.

Commission on Standardization of Biological Stains.

Geneva, N. Y.

H. J. Conn
Chairman

SPECIAL ARTICLES

REVERSE MUTATION OF THE BAR GENE CORRELATED WITH CROSSING OVER

The bar gene of Drosophila melanogaster reverts to its normal or wild-type allelomorph in from thirty to sixty individuals per hundred thousand (May 1917, Zeleny 1918, 1921, 1923). This is a far higher frequency of mutation than is shown by any other locus in Drosophila. We have now found that bar reversion shows a relation to crossing over in the bar region.

Zeleny (1921) found that bar reversions usually occur singly, so that it is not probable that the mutation occurs far back in the history of the germ-cells. It has been the experience of all who have studied bar stocks that in any given specimen the gonads and the eyes are of the same constitution—that is, that a bar-eyed fly breeds as a bar, and a round-eyed fly breeds as a not-bar. These facts further indicate that the bar reversion occurs either late in the history of the germ-cells, or else before the first cleavage division.

If reversion occurs in the germ-cells of both sexes with equal frequency homozygous stocks should produce twice as many heterozygous bar females as wild-type males; if it occurs only in females the number of heterozygous females produced should be equal to the number of wild-type males; if it occurs only in males the reverted offspring should all be heterozygous females. Zeleny (1923) has obtained from homozygous bar stocks a total of fifty-two heterozygous bar females and fifty wild-type males, thus indicating that reversion occurs only (or chiefly) in the germ-cells of females. We can confirm the absence of reversion in males, from extensive experiments in which bar males were mated to not-bar females, without the production of a single reversion.

In an attempt to determine whether the reversion of bar affects one or both chromosomes of a homozygous female, the following experiment was carried out. Females were made up that were homozygous for bar and for the sex-linked recessive eye-color eosin, and that carried a Y-chromosome. These females were also made up in such a way as to give "high" non-disjunction. Such females were mated to vermilion (not-bar) males. Disregarding gynandromorphs, mutations other than bar reversion and a few anomalous results probably due to non-virginity or to mutation, the following counts were obtained by Miss E. M. Wallace:

REGULAR OFFSPRING

red heterozygous bar ♀	eosin bar ♂	red not-bar ♀	eosin not-bar ♂
46518	40303	19	8

Percentage of reversions, .03

EXCEPTIONAL OFFSPRING

eosin homozygous bar ♀	vermilion not-bar ♂	eosin heterozygous bar ♀
12228	11440	1

Percentage of reversions, .008

These results, taken together with the facts previously outlined, at once suggested that bar reversion has something to do with crossing over, since the most striking difference between the regular and exceptional offspring of an XXY female is that the former include almost or quite the normal proportion of crossovers, while the latter are only very rarely crossovers (Bridges 1916). On this view the one eosin heterozygous bar female produced might be interpreted as an "equational" exception (in which case the experiment was inconclusive for the purpose for which it was intended).

The crossover suggestion has now been verified directly in two separate experiments. The two sex-linked recessives forked (f, locus 56.5) and fused (fu, locus 59.5) lie on opposite sides of the bar locus, but are only about three units apart (Bridges 1921). In the first experiment ultra bar (B^u), an allelomorph of bar described by Zeleny (1920) was used. Zeleny has shown that homozygous ultra-bar stocks give rise to reversions to wild-type with about the same frequency as do homozygous bar stocks. In the present case females of the constitution $\frac{B}{f\ B^u\ fu}$ were tested. Three reverted offspring were produced in about 6,500 flies, thus indicating a reversion frequency for the heterozygote that is of about the same order as the frequency in homozygous bar or homozygous ultra-bar. All three of these reverted individuals arose from crossing over between forked and fused: one was forked not-fused and the other two were not-forked fused. In the second experiment ultra-bar was not used and forked and fused were in opposite chromosomes, *i.e.*, the females tested were of the constitution $\frac{B\ fu}{f\ B}$. Three reversions have so far appeared—two wild-type males and one forked fused male. Thus all six reversions in these experiments were accompanied by crossing over between forked and fused; yet such crossovers include only about three per cent. of the total number of individuals examined. It follows that *reversion of bar to normal is associated with crossing over at or near the bar locus.*

A. H. Sturtevant
T. H. Morgan

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THE ABSOLUTE VALUES OF THE ELECTRICAL MOMENTS OF ATOMS AND MOLECULES

Since an atom consists of a number of electrons distributed around a positive nucleus, its effect at an external point at a distance which is large in comparison with the diameter of the atom, is equivalent to an electrical doublet. The nature of the interaction of atoms or molecules in a gas or liquid must, therefore, largely correspond to that of electrical doublets. The writer has pointed out[1] that, since the doublets would tend to set themselves with respect to each other so that the potential energy is a minimum, attraction would be the outstanding force between the molecular doublets, and if repulsion occurs, it would be as small as possible. This is a different view than that taken by Debeye[2], who supposes that attraction is brought about by contractions and expansions of the molecular doublets on approaching and receding from each other, in such a manner that attraction is the outstanding force. But such changes, though probably occurring to a certain extent, need not necessarily exist in order that attraction may be the outstanding force. In any case, the determination of the absolute value of the average electrical moment associated with the atoms or molecules during their interaction in a substance is of outstanding importance.

In dealing with this problem the main difficulty is that the molecular collisions interfere with, or act in opposition to, the tendency of the molecular doublets to set themselves so that the potential energy is a minimum. The extent of this effect can not be calculated without introducing a number of assumptions. It is thus practically impossible to determine the moment of a molecule from data on the internal heat of evaporation of a liquid, the quantity most directly connected with the molecular moments. But this difficulty largely ceases to exist on considering the internal heat of evaporation at the absolute zero of temperature.[3] The average attraction between two molecular doublets in a substance in that case can be shown to be approximately given by

$$4\,\frac{M^2}{r^4},$$

where M denotes the moment of each doublet and r their distance of separation. The values of the internal heat of evaporation at the absolute zero can be exterpolated by means of the empirical latent heat equation

$$L = (\rho_1^2 - \rho_2^2)\,k$$

which is particularly well adapted for this purpose, where ρ_1 and ρ_2 denote the densities of the liquid and vapor respectively, and k a constant which depends only on the nature of the liquid. It is a fairly straightforward process now to show that

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[1] *Phys. Review*, xviii, 4, p. 303, 1921.

[2] *Phys. Zeit.* 21, p. 178.

[3] The details of these deductions are given in a paper in the course of publication in the *Journal of the Franklin Institute.*

$$L_0 = 8.42 \frac{\rho_0}{m_a^2} M^2$$

where L_0 denotes the internal heat of evaporation[4] at the absolute zero, m_a the absolute molecular weight of a molecule, and ρ_0 the density at the absolute zero, which has been exterpolated for a large number of substances by means of Cailletet and Mathias' linear diameter law. Using this equation, the writer has determined the electrical moments of the molecules of a number of substances and found that they were approximately given by

$$M = 10^{-49} \Sigma N^{2/3},$$

where N denotes the atomic number of an atom. It appears, therefore, that the moment of a molecule is equal to the sum of the moments of its atoms, and that the moment of an atom is proportional to the two thirds power of its atomic number which is equal to the number of elementary electrical charges of one sign the atom contains. This result may be taken as good evidence that the molecules of a substance largely interact as if they consisted of electrical doublets.

If x denotes the distance between the charges of the representative doublet of an atom, we have

$$x N e = M$$

or

$$x = 2.09 \times 10^{-10} N^{\cdot 1/3} \, cm.$$

Thus the value of x decreases as the atomic weight increases, which is probably owing to the fact that the larger the number of electrons in an atom, the more symmetrically they may be distributed around the positive nucleus. Moreover, x is also always less than the diameter of the atom, as we might expect. The value 2.09×10^{-10} c.m. of x for the hydrogen atom is much smaller than the value of $.53 \times 10^{-8}$ c.m. of the radius of the circle the moving electron describes around the positive nucleus according to Bohr's theory. Thus in order that the atom may behave as an electrical doublet it is necessary that the nucleus does not occupy the center of the circular path of the electron, but a distance of about 2.09×10^{-10} c.m. from the center at right angles to the plane of motion. Strictly the system will not be in equilibrium by itself under these conditions, but may be when associated with another system. If the electron describes an ellipse with the nucleus at one of the foci, the atom may behave on the whole as a doublet when isolated. The doublet effect of more complicated atoms may be produced along similar lines.

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SIMPLE MILK FORMULAE[1]

Certain formulæ[2] obtain in milk analysis. Among these are:

Fleischmann's:

The mean specific gravity of the milk solids =

$$\frac{T}{T - \dfrac{100G - 100}{G}}$$

where T = per cent. of total solids.
G = specific gravity of the milk.

Babcock's (Hehner & Richmond's):

The per cent. of total solids $= 0.25L + 1.2F$,
where L = lactometer reading $= 10(100G - 100)$
F = per cent. of fat.

Bialon's:

The specific gravity of the fat-free milk =

$$\frac{100G - F}{100 - \dfrac{F}{0.933}}$$

Certain numerical limits in these formulæ are generally recognized: the mean specific gravity of the milk solids does not exceed 1.34 in herd milks above suspicion of skimming,[3] and the

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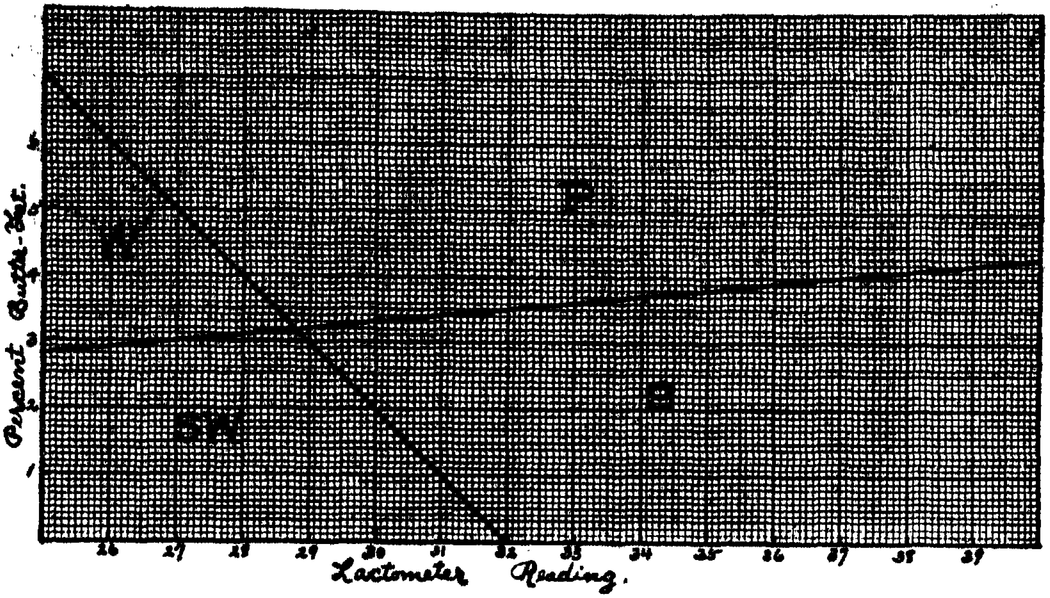
[4] In ergs per gram.

[1] Abstracted from a paper read before the Delaware County Institute of Science, Media, Pennsylvania, May 9, 1921.

[2] More or less adequate discussion of one or more of these milk formulæ are to be found in Bulletin 134, U. S. Dept. Agriculture, Bur. Animal Industry (by Shaw and Eckles) and in books relating to milk control, such as those of Leffmann, Ernst-Mohler-Eichhorn, Barthel, Van Slyke, Race, Jensen-Pearson, Heineman, and particularly in that of Richmond. Books on food analysis, such as those of Leach, Woodman and Allen, also take up milk formulæ more or less completely.



specific gravity of the milk free from fat does not fall below 1.0323 in milks above suspicion of watering.[4] The formulæ given above are not directly connected with the two values that are determined first in a routine milk examination, namely, the specific gravity, G, and the percentage of fat, F. Rules that show F as a function of G are needed, for these two values are the logical bases upon which to sort out milks above suspicion of skimming and watering. This paper calls attention to such rules:

Rule I. Add 3 to the lactometer reading, and then divide by 10. The result is the minimum percentage of fat to be expected in that milk if it is above suspicion of skimming.

Rule II. When lactometer readings from 26 to 30 are arranged in ascending order, the corresponding minimum percentages of fat in herd milks above suspicion of watering are whole numbers arranged in descending order from 6 to 2.

Rule 1 is derived as follows: Put the limiting value (1.34) for unskimmed herd milk into Fleischmann's formula; substitute for percentage of total solids, T, in Fleischmann's formula this same value as it is defined by Babcock's formula; and solve for an equation representing $F = (f)G$. This will be found to be

$$F = \left(\frac{3.284}{G} - 2.083\right)(100G - 100) \quad . \; . \; . \quad (4)$$

Using in (4) known values of G between the usual limits, namely, 1.025 to 1.040, and solving for F, a table of values is gotten that shows Rule I clearly, and also shows that Rule I gives values for F within about 0.02 per cent. of those calculated by equation (4).

Rule II is derived as follows: Put the limiting value 1.0323 for unwatered herd milks into Bialon's formula, and solve for an expression representing $F = (f)G$. This expression will be found to be

$$F = 969.927 - 939.579G \quad . \; . \; . \; . \quad (5)$$

Using in (5) known values of G between the limits 1.026 and 1.030 and solving for F, a table of values is gotten that shows Rule II clearly, and also shows that Rule II gives values for F within 0.1 per cent. on the average when compared with those calculated by equation (5). As 0.1 per cent. is approximately the average error in the routine determination of butter-fat in milks, this may be neglected.

Plotting Rules I and II gives a diagram that covers the values of F and L met with in routine work, and that shows the region where the two rules overlap.

These simple rules are recommended as guides in sorting out early in the examination of any number of herd milks those that are above suspicion of skimming and watering.

DAVID WILBUR HORN

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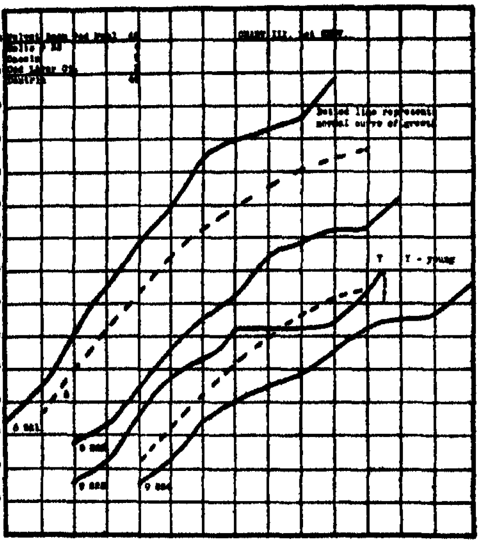
[3] Woodman: "Food Analysis," New York, 1915, p. 139.

[4] Barthel: "Die Methoden z. Untersuchung v. Milch u. Molkereiprodukten," Leipzig, 1911, p. 135.

CONCERNING THE VITAMIN B CONTENT OF THE VELVET BEAN

THE question as to whether or not the seed of the velvet bean contains vitamin B in any appreciable quantity has recently been raised by Dr. E. R. Miller,[1] of the Alabama Station, and still more recently by Professor W. D. Salmon, of the South Carolina Experiment Station. In SCIENCE for September 29, 1922, Professor Salmon reports the results of certain experiments in which three groups of mature pigeons suffered ill consequences in a strikingly short period of time when they were fed ground raw velvet bean seed. The statement is also made that the results of certain experiments indicate at least a small quantity of the B vitamin in the velvet bean.

Sure and Read, in their paper reporting the "Biological analysis of the seed of the Georgia velvet bean" which appeared in the *Journal of Agricultural Research* for October 1, 1921, Vol. XXII, No. 1, called attention to the high degree of toxicity of the raw ground velvet beans when fed to rats. Young rats weighing from 40 to 90 grams existed only from 7 to 12 days on a diet composed solely of ground raw velvet bean seed and a liberal supply of distilled water. Miller[2] had previously pointed out that the toxicity of the velvet bean may be due to the presence of dihydroxyphenylalanine. In our paper we reported that the concentration of vitamin B in the seed, exclusive of the tough seed coats and also the seed pods, was low. In a recently completed study of the biological value of velvet bean meal (*i. e.*, the beans and pods ground together) the writer has found that the velvet bean meal carries a good concentration of the B vitamin, even after autoclaving for one hour at 15 pounds pressure. This is shown in the growth curves given in the figure.



This chart shows the growth of young rats on a ration carrying 40 per cent. autoclaved velvet bean meal as the only source of vitamin B. This ration contained all the other dietary essentials in satisfactory amounts.

These experiments show that vitamin B is relatively abundant and stable towards heat in the thick seed pods of the velvet bean, but is of rather low concentration in the seed.

J. W. READ

ARKANSAS AGRICULTURAL EXPERIMENT STATION

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY. III.

New methods of splitting pyrimidines. The action of hydrogen peroxide and of sodium pentacyano-aquo-ferroate on thymine: OSKAR BAUDISCH and LAWRENCE W. BASS. Previous experiments have shown that the system $FeSO_4$ + $NaHCO_3$ + air splits thymine with the formation of urea, acetol and pyruvic acid. The observation was made that the same products are obtained, but in different quantities, by using hydrogen peroxide, either alone or with traces of ferrous salts. The splitting of thymine by sodium pentacyano-aquo-ferroate yields pyruvic acid alone or pyruvic acid with traces of acetol. These facts are important for explaining the mechanism of the reaction.

New methods of splitting pyrimidines. The action of iodine solution and sodium bicarbonate on thymine: OSKAR BAUDISCH and LAWRENCE W. BASS. By the action of an aqueous solution of iodine and potassium iodide in the presence of sodium bi-carbonate, the pyrimidine ring can easily be split under mild conditions. In the case of thymine the products obtained are urea and acetol; no pyruvic acid is found. The fact that pyruvic acid is not formed is of special interest, since it was always present as a reaction product when the split was brought about by $FeSO_4 + NaHCO_3 +$ air, by H_2O_2 alone or with ferrous salts, or by sodium pentacyano- aquoferroate.

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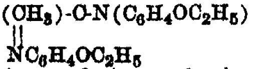
[1] Do velvet beans contain Vitamin B? Paper presented by Dr. Miller before the Division of Agricultural and Food Chemistry at the April (1922) meeting of the American Chemical Society, Birmingham.

[2] Miller, Emerson R., "Dihydroxyphenylalanine, a constituent of the velvet bean," *Jour. Biol. Chem.*, V. 44, No. 2, p. 481-486, 1920.

The action of diazomethane on cyclic ureides: A. J. Hill and F. H. Case. With the object of throwing light on the linkage of the pyrimidine constituents in nucleic acids, both the former and the latter types of compounds are being investigated in regard to their behavior towards the methylating agent diazomethane. Uracil, thymine and 4-methyl uracil, suspended in ether solution and treated with diazomethane, dissolve completely and each yields the corresponding dimethyl derivative. On the other hand, cytosin dissolves but slightly and the insoluble residue appears to be a new crystalline modification of this compound. It has been necessary to synthesize the hitherto unprepared 2-oxy-6-methylamino pyrimidin in order to assist in the identification of the ether soluble product in the cytosine methylation.

Local anesthetics of the holocaine type: A. J. Hill and I. Rabinowitz. This investigation was undertaken for the purpose of increasing the efficiency and lessening the toxicity of the local anesthetic "holocaine,"  $(CH_3)\text{-}\underset{\underset{NC_6H_4OC_2H_5}{\|}}{C}\text{-}N(C_6H_4OC_2H_5)$ by systematic modifications of its molecular structure at the positions indicated by the bracketed portions of the above formula. In the types of compounds thus far prepared methyl has been replaced by aliphatic groups, such as ethyl and propyl, and by the aromatic benzyl. A new method has been developed for the synthesis of "holocaine," which depends upon the interaction of p-phenetidine and the hydrochloride of acetimino-ethyl ether.

The catalytic decomposition of glycerides: Francis L. Simons and Treat B. Johnson. Several simple triglycerides have been decomposed over ThO_2 at varying temperatures (350°-650°), and the composition of the products formed determined quantitatively. At the lower temperatures apparently a straight degradation of the glyceride into acrolein, fatty acid and small amounts of the di- and mono-glyceride takes place; higher temperatures favor the formation of more complex compounds. A new method of handling fatty acids (analytically) being developed in this laboratory by Dr. Donleavy has been given practical application in this work and found to work successfully. The investigation is still in progress and it is hoped that sufficient data will be uncovered to permit us to establish the general mechanism of these interesting decompositions.

The biochemical importance of the system: formaldehyde, ammonia and prussic acid: T. B. Johnson and H. W. Rinehart. A thorough investigation of the reactions occurring when formaldehyde, ammonia and prussic acid are allowed to interact is essential to an accurate understanding of the primary reactions taking place in plant growth. One substance formed by interaction of these three reagents is "methyleneaminoacetonitrile" $CH^2{:}NCH_2CN$. This is formed under conditions which are not well understood, and it has been reported in chemical literature that this substance can exist in isomeric modifications. Only one of them has received attention. Data has already been obtained which indicates that the isomerism is probably not physical isomerism. We find that the statements made regarding the molecular weight of these isomers is inaccurate. Furthermore, practically nothing has been published giving a true picture of constitution. We find that each compound is characterized by its crystalline habit. They are trimolecular compounds and are so constituted structurally as to reveal the presence of free cyanide groups. In many ways, they exhibit the properties of plant alkaloids. More work is in progress and an effort is being made to establish a constitutional formula.

The hydrogenation of several pyridine derivatives: T. B. Grave and E. Emmet Reid. Prolonged shaking with hydrogen under 3 atmospheres pressure in presence of platinum black hydrogenates 1-methyl-2-pyridone only to the tetra-hydro. The same has been found true of 2-amino-pyridine in a variety of solvents. When the hydrogenation is pushed further there is decomposition with elimination of ammonia. Tetrahydro-2-amino-pyridine is unstable and readily breaks up when set free from its salts by alkali. It gives tests for the primary amino group, but does not react with nitrous acid. 2-methyoxypyridine is hydrogenated directly to piperidine with loss of the methyoxy group.

The alkylation of benzene: T. M. Berry and E. Emmet Reid. Benzene has been alkylated by passing propylene in presence of aluminum chloride with high speed stirring. The isopropyl group is readily introduced in this way with the formation of mono and the poly-isopropyl-benzenes. The most of these up to the tetras have been isolated and identified. The isopropyl group can be introduced into toluene and napthalene by the same means.

Organic mercury compounds related to triphenylmethane dyes and azo dyes: E. R. Hanson, G. J. Leuck and F. C. Whitmore. Preliminary paper. Direct mercuration of triphenylmethane dyes has been found to be very difficult. The process takes place more readily in the aurin series than in the rosaniline series. A large number of soluble mercurated azo compounds have been obtained by coupling diazonium salts from aminobenzoic acids, sulfanilic acid, naphthionic acid and a number of amino dye intermediates with ortho mercurated phenol and with dimercurated para cresol. In the first case the coupling takes place in the para position, leaving the mercury group unchanged. In the second instance one of the mercury atoms is replaced during the coupling.

Reaction of organic mercury compounds with non-metal halides: Neal Thurman and Frank C. Whitmore. Preliminary paper. Of a very large number of halides studied the first to give clean-cut results was para toluene sulfone iodide which gives a good yield of para ditotlyl sulfone with para mercury ditotlyl. In most cases the organic mercury compound does not act with the halide except under conditions which lead to complete decomposition. Tertiary iodides yield organomercuric iodides and olefins.

The electrolytic reduction of maleic, fumaric and cinnamic acids, and the electrolytic production of amino salicylic acid: James F. Norris and E. O. Cummings. The fumaric and maleic acids furnish about 90 per cent. of the theoretical yield of succinic acid when reduced electrolytically. The yield of hydrocinnamic acid under the proper conditions is also about 90 per cent. of the theoretical. The product formed by condensing benzene diazonium chloride with salicylic acid was converted with a good yield into amino salicylic acid when titanium chloride was used as a catalyst. The production of this acid was accomplished more readily by reducing the diazonium compound with titanium chloride and regenerating the latter electrolytically.

The influence of environment on the reactivity of a chlorine atom: James F. Norris and Clifford Banta. The rates at which diphenyl chloromethane and several of its substitution products react with alcohol have been determined. The reaction was followed by the measurement of the conductivity of the hydrogen chloride formed as a result of the reaction. The compounds were selected because the reactions involved are reversible and proceed at such rates that the latter can be measured at 25 degrees. The velocity constants of the opposing reactions in the case of some of the compounds are as follows:

$(C_6H_5)_2CHCl + HOC_2H_5$ K_1 $(C_6H_5)_2CHOC_2H_5 + HCl$

	K_1 K_2	K_2
$(C_6H_5)CHCl$	$.0_3 1205$	.001495
p Chlor.	$.0_4 5176$	$.0_2 7240$
p Me	$.0_2 2491$	.2657
p Phenyl	$.0_4 1546$	$.0_2 1278$
o Chloro	$.0_5 1170$	.05109

Characteristics of two crystalline forms of glycine: C. A. Brautlecht and N. F. Eberman. Investigations of glycine have shown a number of physical and chemical differences. Emil Fischer, Ber. xxxviii, 1914 (1905) noticed that the plate and needle forms of glycine reacted differently to phosphorus pentachloride and acetyl chloride mixtures. He made no explanation of the difference. Ostromisslensky, in 1908, reported that one form of glycine precipitates one form of *l* asparagin from saturated solution, while the other does not. Some investigators consider glycine crystals as belonging to hemihedral division of the orthorhombic system, while others consider them as belonging to the monoclinic system. Various investigators then concluded that glycine might exist with the inner ammonium structure, especially when in solution. Further experimental evidence was therefore considered desirable to arrive at an understanding of the chemistry of glycine, a substance of basic importance both from the pure organic and biological chemical viewpoint. Following the suggestions offered by Falk and Seguira, *J. Biol. Chem.*, xxxiv, 29 (1918), who studied the action of bromine on the two crystalline forms of glycine, the authors of this paper report the results of melting temperature determinations of several samples of the two forms, alone and in mixtures, the action of heat, dry and moist hydrogen chloride, dry and moist sulfur dioxide, dry and moist bromine and acetyl and phosphorus chlorides on the two crystalline forms of glycine. The conclusions reached are that there is no chemical difference between the two crystalline forms of glycine in the dry state, and that in Fischer's experiments acetyl chloride, in presence of phosphorus pentachloride, reacted in a complicated manner.

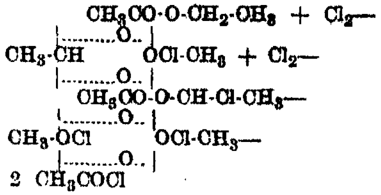
Some substituted aryldialkyl amine oxides: Lauder W. Jones and Elder B. Hartshorn. Meta and para nitro dimethyl aniline and para brom-dimethylaniline were oxidized by Caro's acid to the corresponding amine oxides, and isolated as sulfates. Other characteristic salts were prepared, the hydroiodides partially undergoing spontaneous intramolecular oxidation and reduction to the amine, iodine and water. Their stability seems to be a measure of the firmness with which the oxygen is bound to the nitrogen. The free bases prepared by the action of silver oxide on the hydrochloride do not react with methyl iodide to form stable addition products as do the trialkyl amine oxides.

Studies in cellulose chemistry (Part 8). Use of acetylene for the synthesis of cyclic acetals: **Harold Sanford Hill** and **Harold Hibbert.** By adding small amounts of conc. sulfuric acid and mercuric sulfate to a polyhydroxy derivative (glycols; glycerine) and passing acetylene into the mixture at temperatures ranging from 20° to 50°C. good yields of the corresponding cyclic acetals are obtained. The best results are found when very vigorous agitation is employed. This method is being applied to other poly-hydroxy derivatives.

Studies in cellulose chemistry (Part 9). Partition experiments in the formation of cyclic acetals: **Harold Sanford Hill** and **Harold Hibbert.** The method outlined in the previous abstract has been used to determine the nature of the partition in the formation of cyclic acetals comprising both five and six-membered rings. Using a mixture of one mole of a 1:2 and a 1:3 glycol and passing in only enough acetylene to combine with one of the glycols, it was found, in agreement with the previous work of Hibbert and Timm on this subject, that the tendency toward six-membered rings formation is much more pronounced than that of five.

Studies in cellulose chemistry (Part 10). The action of traces of iodine on organic esters: **Harold Hibbert.** The study of polysaccharides is concerned with the properties of the hydroxyl and carbonyl groups, especially under the influence of catalysts. Unfortunately we are still quite in ignorance as to the mechanism of such fundamental reactions as the polymerization, condensation and halogenation of aldehydes, ketones and related compounds. Up to the present no explanation has been given to the mechanism involved in the ready transformation of aldehydes into esters under the influence of traces of aluminum alkylates (Tishchenke), a change evidently closely related to the Cannizzaro reaction. A consideration of the mechanism involved in such ester formation, as well as that relating to the halogenation of organic esters, leads to the conclusion that both are intimately related.

Studies on cellulose chemistry (Part 11). The action of chlorine on organic esters: **Ralph S. Montonna** and **Harold Hibbert.** No satisfactory explanation has been given of the ready transformation of benzyl benzoate into benzoyl chloride under the influence of chlorine. Authors' experiments on the chlorination of ethyl acetate indicate the reaction takes place in the following stages:



$$CH_3CO{\cdot}O{\cdot}CH_2{\cdot}CH_3 + Cl_2 \text{—}$$
$$CH_3{\cdot}CH \quad OCl{\cdot}CH_3 + Cl_2 \text{—}$$
$$CH_3CO{\cdot}O{\cdot}CH{\cdot}Cl{\cdot}CH_3 \text{—}$$
$$CH_3{\cdot}OCl \quad OCl{\cdot}CH_3 \text{—}$$
$$2\ CH_3COCl$$

Evidence is being accumulated with a view to showing that all alpha chlor-esters (III) exist as cyclic rather than as open chain compounds.

Tuberculinic acid—the nucleic acid of tubercle bacilli: **Elmer B. Brown** and **Treat B. Johnson.** Large amounts of tubercle bacilli, consisting of human and bovine types, have been subjected to analysis and hydrolysis and the nucleic acid purified and analyzed. An acid hydrolysis of this acid (tuberculinic acid) has revealed the presence of thymine and cytosine as normal pyrimidine constituents. Repeated examination has failed to reveal the presence of uracil. The usual purines, guanine and adenine are also present. An examination of the hydrolysis solution has produced evidence which proves that a hexane sugar functions in this nucleic acid molecule. Both formic and lævulinic acids have been identified, being produced in large amounts. Only very small amounts of furfuraldehyde are produced on hydrolysis.

Salts of pseudothioureas and their application in the identification of organic acids: **J. J. Donleavy** and **T. B. Johnson.** In the course of investigations dealing with the chemistry of fats, and the determination of structure of salts of pseudothioureas, it has been found that certain of these organic bases are characterized by their property of forming well-defined crystalline salts with the common organic acids. The salts so far examined are unique in that they are easily obtained in crystalline form, have definite melting points and serve admirably for purposes of identification. Thus far benzyl pseudothioureas has been the base which has received the most attention. It seems very probable that an analytical procedure may be developed through the use of these salts which will simplify our present methods of analyzing mixtures of organic salts.

The catalytic decomposition of formic acid: **C. J. Engelder** and **B. B. Westcott.**

The electronic conception of valence and heats of combustion of organic compounds: **M. S. Kharasch** and **B. Sher.**

Charles L. Parsons,
Secretary

THE AMERICAN GEOPHYSICAL UNION AND ITS SECTIONS

THE fourth annual meeting of the American Geophysical Union and its Sections was held at the Carnegie Institution, Washington, D. C., on April 17-19, 1923.

In the forenoon of April 17 the following general addresses were given:

"Organization and aims of the National Research Council" by Dr. Vernon Kellogg, permanent secretary of the Council.

"The organization and work of the International Research Council" by Dr. R. A. Millikan, a delegate to the Brussels meeting in 1922.

"The organization and aims of the American Geophysical Union" by the chairman of the Union, Dr. L. A. Bauer.

"The organization and aims of the National Geodetic and Geophysical Committee of Canada" by a delegate from Canada, Mr. Noel Ogilvie, superintendent of the Geodetic Survey of Canada.

On the afternoon of April 17, a statement was made by the representative of each of the sections of the union, *i.e.*, geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology and geophysical chemistry. The statements covered the status, scope and problems of science represented by the several sections.

On the evening of the seventeenth a banquet was held at which addresses were made by Congressman H. W. Temple on "Economic value of governmental scientific work" and Dr. E. E. Slosson on "Science and the public." Remarks were made on international and national work in geophysics by Colonel E. Lester Jones, director of the United States Coast and Geodetic Survey; Captain Frederic Bassett, hydrographer of the United States Hydrographic Office, and Professor C. F. Marvin, chief of the United States Weather Bureau.

Meetings were held by the seven sections of the union on April 18 and the forenoon of April 19, at which a total of forty-nine scientific papers or communications were presented. It is expected that abstracts of these papers will appear in the printed proceedings of the annual meeting of the union.

In the afternoon of April 19, there was a general business meeting of the whole union at which reports were received from the officers of the union, of the sections and of the committees. After discussion a number of resolutions dealing with scientific questions were adopted. The most important of these resolutions and one which is of special interest to the scientific public reads as follows:

> *Whereas*, the United States Statutes at Large, Vol. 37, p. 913, provide that
>
> "Hereafter the executive shall not *extend* or accept any invitation to participate in any international congress, conference or like event, without first having specific authority of law to do so,"
>
> *And, whereas*, since other provisions of law make it impossible for officers of the government to attend and participate in an official capacity in any international foreign congress, convention, meeting or gathering, thus greatly embarrassing the scientific departments of the government in conducting the important duties and responsibilities devolving on them, and since the principal object of such congresses, conventions, meetings or gatherings is to secure between nations the most effective and profitable cooperation in scientific matters;
>
> *Therefore*, be it resolved that the American Geophysical Union recommend to the National Research Council that appropriate action be taken to present to the Congress of the United States the disadvantages resulting from the effects of the laws referred to above, with the object of securing the necessary legislation permitting the executive and the heads of the various departments to designate duly accredited representatives to attend international foreign scientific congresses, conventions, meetings or gatherings. This legislation should apply especially to meetings of the International Research Council and its branches and the International Meteorological Committee and like organizations.

In response to an invitation from the chairman of the union, the following representatives of Canada attended and took part in the annual meeting of the union and its sections: Mr. Noe Ogilvie, superintendent of the Geodetic Survey; Dr. W. Bell-Dawson, superintendent of Tidal and Current Surveys; Mr. J. Patterson, meteorologist, Meteorological Service.

A list of the titles of papers read at any of the section meetings can be obtained by communicating with the secretary of the union at the United States Coast and Geodetic Survey, Washington, D. C.

WILLIAM BOWIE,
Secretary

AMERICAN GEOPHYSICAL UNION

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